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Steel Deck Institute Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Deck Floor Systems with Electrical Distribution

Steel Deck Institute

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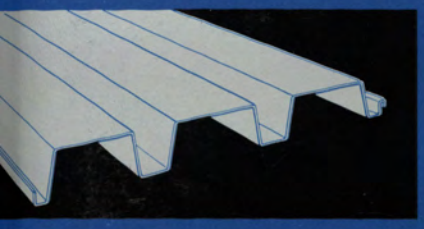
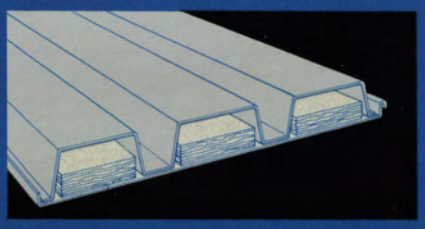
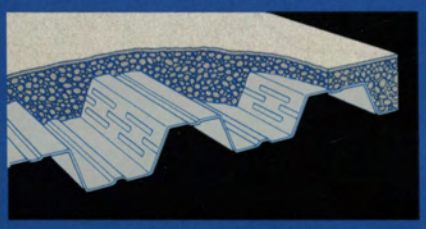
Publication No. 29



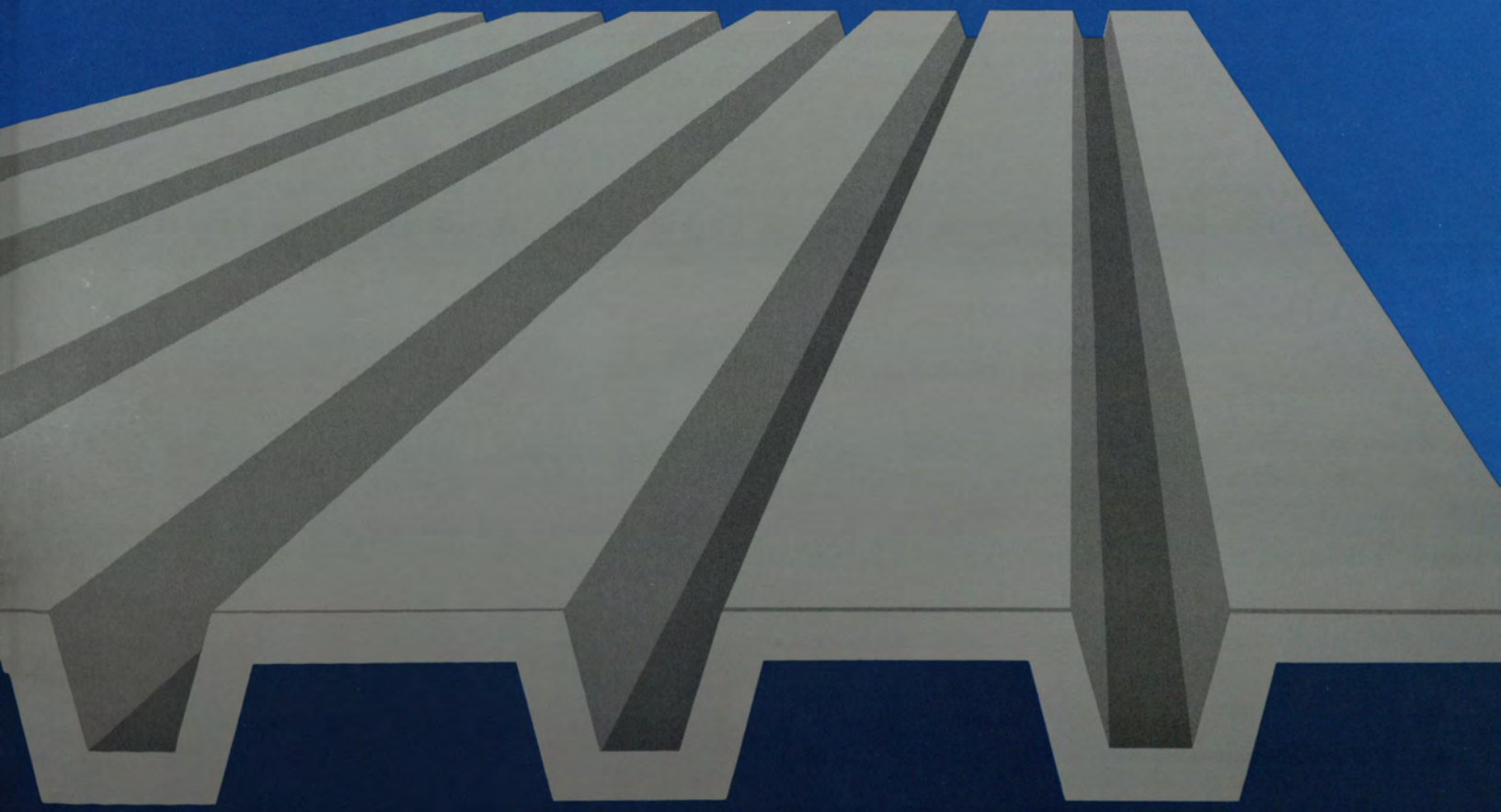




STEEL DECK INSTITUTE sdi®

Steel Deck Institute DESIGN MANUAL

For Composite Decks, Form Decks, Roof Decks and Cellular Deck Floor Systems with Electrical Distribution



The Steel Deck Institute

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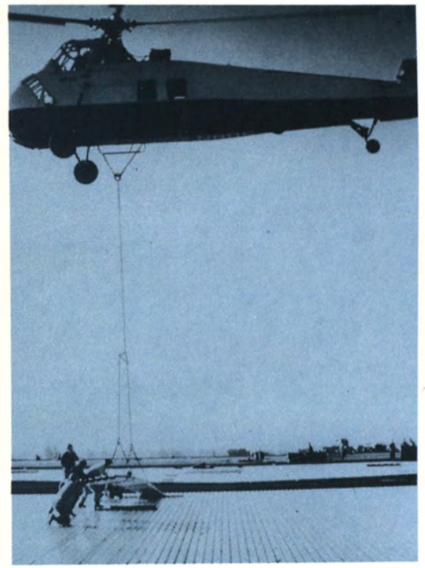
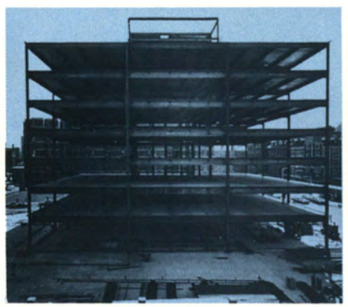
Before making use of this manual, please review special notice on page 52.

Steel Deck Applications





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The Steel Deck Institute reserves the right to change, revise, add to, or delete any data contained in this manual without prior notice.

STEEL DECK INSTITUTE
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The Steel Deck Institute

Since 1939, the Steel Deck Institute has provided uniform industry standards for the engineering, design, manufacture, and field usage of steel decks.

The SDI is concerned with cold-formed steel products, with various configurations distinctive to individual manufacturers, used to support finished roofing materials or to serve as a permanent form and/or positive reinforcement for concrete floor slabs.

Members of the Institute are manufacturers of steel floor and roof decks. Associate members are manufacturers of fasteners, coatings, and other related components, contractors, and others in the field who share SDI interests.

The Institute is managed by an executive director who supervises the programs developed through the combined efforts of the total membership.

Continuing SDI functions include preparation, review, and distribution of literature, referral of inquiries to appropriate sources, coordination of research and testing, and liaison with other construction industry associations on matters of common interest.

The purpose of these functions is three-fold:

1. To develop steel decks that are engineered for structural soundness, that maintain consistent quality, that adapt to a wide range of designs and systems, and that are economical in both initial and life-cycle costs.
2. To initiate design and installation procedures that conform to good construction practices and that meet cost requirements.
3. To make this information readily accessible to designers and owners.

Design Manual for Composite Decks, Form Decks and Roof Decks

Since steel decks were originally used only for roof construction, the Steel Deck Institute traditionally limited its attention to roof assemblies.

For more than 20 years, however, SDI members have been manufacturing steel decks for floor assemblies. These companies have developed floor deck engineering data and have established performance standards through laboratory testing and field usage.

In 1975, SDI members concluded that the Institute should expand its design manual to include floor decks used either in composite slab design or as a permanent form. In 1989, it was further expanded to include cellular metal floor deck with electrical distribution.

The result is this publication, the *Steel Deck Institute Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Decks with Electrical Distribution,* a definitive guide to the proper design and specification of steel decks.

Standards

- The SDI developed the following standards for steel floor decks, roof decks, and related products:
- Replaced gage with design thickness as the unit of measure in references to material thickness;
- Established manufacturing tolerances;
- Developed site storage and erection recommendations;
- Standardized accessories—sump pans, ridge and valley plates, and cant strips;
- Developed specifications for Composite Steel Floor Deck, Non-Composite Steel Form Deck, Steel Roof Deck, and Cellular Metal Floor Deck with Electrical Distribution;
- Defined standard roof deck sections and issued standard load tables for narrow, intermediate, wide rib and deep rib decks.

Testing

Independent tests are the best guide to product performance and reliability, a philosophy to which Steel Deck Institute members subscribe. Their support for an ongoing program is indicated by the number and scope of tests already performed and by their policy of sponsoring new tests when new products or applications are introduced by the industry.

Following are completed roof deck tests for which published results are available:

- U.L. Fire Ratings: two-hour steel deck assembly; acoustical ceiling with wide joist spacing; steel roof assembly with directly applied insulation;
- National Bureau of Standards fire tests on various steel roof deck constructions;
- Steel Deck Diaphragms.

SDI manufacturers can furnish fire ratings, load test results, and other performance test reports for their own products.

Roof Deck Certification Program

The Steel Deck Institute offers deck manufacturers (both members and non-members) certification of product design through an engineering analysis by independent consulting engineers. To receive design certification for a roof deck section, a manufacturer must submit a profile with dimensions and a load table (either his own or the SDI Standard Load Table) to the SDI. A computer program analyzes the profile and dimensions and produces a load table. If the manufacturer's stated safe loading is verified by the computer analysis, the SDI issues a certificate which states that the product is designed in accordance with SDI Specifications and also verifies the manufacturer's load tables.

OTHER PUBLICATIONS:

The Steel Deck Institute Diaphragm Design Manual

An essential, comprehensive and practical reference for Engineers, Architects, Detailers, Draftsmen, Contractors, Building Officials and people engaging in the design and use of Steel Deck and Steel Structures.

This hard-bound manual represents a full-scale diaphragm study conducted over the past 20 years by Dr. Larry Luttrell at the Major Units Laboratory of West Virginia University. This is publication No. DDM01 and may be purchased from the SDI.

The Steel Deck Institute Diaphragm Design Manual Second Edition

Published in November 1987, this basic, user friendly manual for practicing Engineers and Architects contains expanded and up-dated chapters on Diaphragm strength, Diaphragm stiffness, Connections and Filled Diaphragms. Includes clearly illustrated and explained design examples, organized for easy use.

Dr. Larry Luttrell, Professor Civil Engineering, West Virginia University and Advisor for the STEEL DECK INSTITUTE provides a reference source that contains the answers to all your questions. This is publication No. DDM02 and may be purchased from the SDI.

Comprehensive Steel Deck Institute Binder

A complete, hard-bound encyclopedia containing valuable, tabulated material for Composite Decks, Form, Decks, and Roof Decks.

This manual provides State-of-the-Art product catalogs of SDI Member Manufacturers, and publications of Associate Members who furnish items used in steel deck construction. This publication is available through the SDI.

SDI Manual of Construction with Steel Deck

First edition-1991—Easy to read and follow. This publication reviews good practice in Steel Deck Construction and serves as a safety primer for Contractors, Erectors, Architects, Engineers and Inspectors who are responsible for safe and proper field installation of steel deck. This is publication No. MOC1 and may be purchased from the SDI.

LRFD Design Manual for Composite Beams and Girders with Steel Deck

An accurate 1,000 page Design Notebook to aid Engineers working with Steel Frames and Steel Decks. Economical Design using LRFD Simplified for Composite Beams with Steel Deck Slabs. This is publication No. LRFD1 and may be purchased from the SDI.

Composite Deck Design Handbook

Standard load tables for 1.5″, 2″, 3″ steel deck. Quick selection tables with normal and light weight concrete. Deck with and without studs for spans to 16 feet. Example problems showing design with heavy concentrated loads including impact. Written in language for Design Engineers and Design Professionals. This is publication No. CDD1 and may be purchased from the SDI.

Standard Practice Details

For Composite, Non-Composite and Roof Decks. Beam Details; Pour Stop Table; Stud Locations; Girder Filler; Cell Closures; Installation Notes—studs on beams and studs on girders; Details for Steel Forms; Attaching: Construction Details for Roof Decks; Diaphragm Welding Example and Details; Roof Deck Accessories. VERY USABLE—VERY PRACTICAL. This is publication No. SPD1 and may be purchased from the SDI.

LRFD Floor Design Software

A knowledge-based system for designing Composite and Non-Composite beams and girders with Steel Deck using documented AISC rules.

Design a Complete Bay. Incorporate the use of all grades of steel or concrete. Specify live loads, dead loads, line loads, tributary area loading and concentrated loads. Set deflection limits. Specify code area reductions. Obtain vibration analysis for final design. Print complete design calculations. Print design tables. May be purchased from the SDI.

The Steel Deck Institute

ADVANTAGES OF STEEL DECK:

Versatility

Steel decks complying with SDI Specifications are available from the member companies in various depths and rib spacings, with and without stiffening elements, with and without acoustical material, cellular and non-cellular, and in varying material thicknesses. This extensive choice makes steel deck applicable to a wide range of projects and structural designs.

Structural Strength with Less Weight

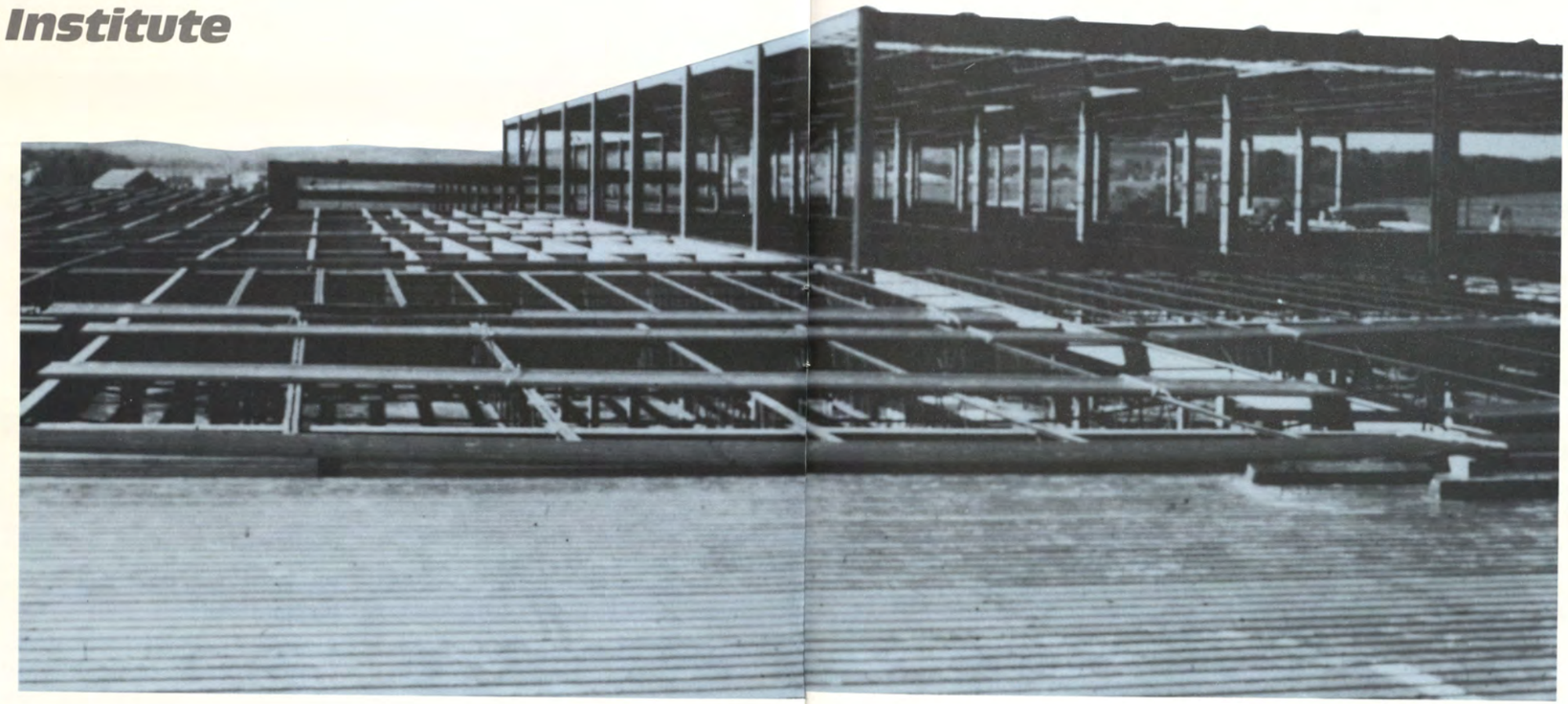
The properties of steel are used with maximum efficiency in the design and fabrication of steel decks, resulting in products with a high strength-to-weight ratio. As a result, delivery, erection, and structural framing costs can be lower than with other systems.

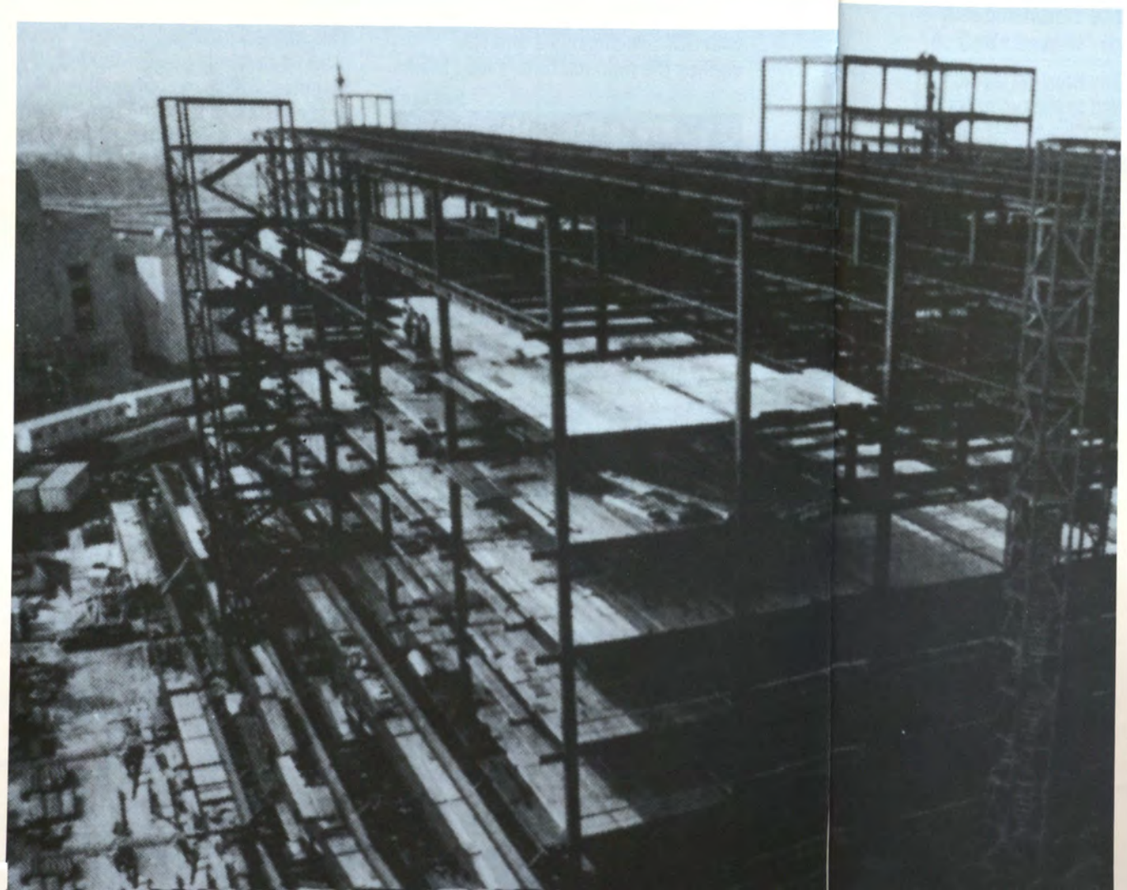
Attractive Appearance

Although steel deck is primarily a structural component, it is visually attractive when left exposed in other applications. With the properly specified factory and field coatings, steel deck is easy to maintain, durable, and esthetically pleasing.

All-Weather Construction

Steel deck can be erected in most weather conditions, eliminating the costly delays that can occur with other types of roof systems.





Required Fire Ratings

U.L. fire resistance ratings on standard roof and floor assemblies have been obtained by the Steel Deck Institute. Individual SDI manufacturers have ratings on their own products. Most fire resistance requirements can be met with products manufactured by SDI members.

Uniform Quality

Through engineering and continuously refined production techniques, SDI manufacturers produce decks that conform to specified standards.

Proven Durability

Steel deck in place and performing satisfactorily for more than a half-century is indicative of the product's durability.

Economy and Value

Value is determined by combining initial costs, life-cycle costs, and overall performance. Steel deck assemblies are the best value in roofing designs. They combine low cost with top performance.

Code of Recommended Standard Practice

FOR COMPOSITE DECK, FORM DECK, AND ROOF DECK CONSTRUCTION

1. General

1.1 Scope: This code is intended to promote safety and quality construction in accordance with good engineering practice. It is designed to assist in the preparation of the sales contract by providing contract details which can be adopted by reference.

1.2 Application: This code shall govern where building codes, architects' and engineers' plans and specifications or contracts are not complete or clear. There shall be no conflict between this code and any legal building regulation; it shall only supplement and amplify such laws.

1.3 Design: In the absence of ordinances or specifications to the contrary, design shall be in accordance with the current Specifications of the Steel Deck Institute. Steel roof deck and floor deck, both composite and non-composite, may be used in a variety of ways, some of which do not lend themselves to a standard "steel deck" analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

1.4 Plans and Specifications for Bidding: Plans and specifications shall clearly show details and shall be complete as to the extent of deck and accessories to be furnished by the seller.

1.5 Responsibility for Design: When details of design are specified, the seller shall assume no responsibility other than to furnish materials as specified. When details of design are not specified, the seller shall furnish all materials required in accordance with Section 1.3 of this code.

2. Bidding

2.1 Base Bids:
2.1.1 Roof Deck: Base bids shall include roof deck as shown in plan on structural drawings. Base bid shall also include ridge and valley plates and sump pans per architectural drawings and specifications. No other deck or accessories shall be included unless specified.

2.1.2 Composite Floor Deck and Non-Composite Form Deck: Base bids shall include deck as shown in plan and only those accessories specifically designated on the structural drawings and called for in the appropriate division of the specifications. No other deck or accessories shall be included unless specified.

2.2 Incomplete Plans and Specifications: Incomplete plans and specifications shall be bid on the basis that the seller shall provide material in agreement with the provisions of this code.

2.3 Special Details: Any material required to support the steel deck shall not be included. The design of deck supports shall be the responsibility of the architect and/or engineer of record. Deck shall be furnished in sheet lengths of 6 feet (2.0 m) or greater. Any deck sheets requiring lengths less than 6 feet (2.0 m) shall be field cut by others unless special arrangements are made with individual manufacturers.

3. Drawings and Specifications

3.1 Furnished by Buyer: The buyer shall furnish complete architectural plans and specifications, structural steel drawings, and purlin placing plans, all correctly dimensioned.

3.2 Furnished by Seller: The seller shall furnish erection layouts clearly showing the location of all sheets. The seller shall also furnish as many prints as may be reasonably necessary, but the tracing shall remain the property of the seller.

3.3 Discrepancies: The architect's plans shall be assumed to be correct in the absence of written notice from the buyer to the contrary. When structural steel or purlin placing plans do not agree with the architect's plans, the structural plans shall be considered as a written notice of change of plans.

3.4 Approval: The erection layouts shall be submitted to the buyer for approval unless the buyer instructs the seller to submit same directly to the architect or waives his right of approval. The buyer (or architect) shall return one copy marked with his approval or with such corrections as he may deem necessary. The seller shall not start shop work prior to final approval of his drawings unless such approval is waived.

The deck manufacturer is not responsible for putting a professional seal or signature on erection drawings. Erection drawings are made to show the deck products as an overlay on the structural or architectural plans and as such the drawings are trying to meet the job requirements set forth by the designer. If the deck manufacturer were to check and seal erection drawings, it would subvert that important function.

3.5 Changes by Buyer After Approval: When any changes are made by the buyer after approval or when any extra materials are required, the cost of such changes and extra materials shall be paid by the buyer at a price agreed upon between the buyer and seller.

4. Collateral Material

Although certain collateral materials are not supplied by the steel deck manufacturer, it is the desire of the Steel Deck Institute to have certain principles followed in specifying and furnishing these collateral materials in order to provide a satisfactory deck assembly. This code is not intended to encroach upon the standard practices of the related industries, but is intended to supplement and amplify specifications pertaining to their products.

4.1 Insulation: All steel roof decks shall be covered with a material of sufficient insulating value to prevent condensation under normal occupancy conditions. Insulation shall be adequately attached to the steel roof deck by adhesives or mechanical fasteners. Insulation materials shall be protected from the elements at all times during their storage and installation.

The following paragraph 11.3, Phenolic Foams has been extracted, with permission, from the Annual Book of ASTM Standards, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

11.3 PHENOLIC FOAMS may contain some compounds which may promote corrosion in the presence of liquid water. As far as can be ascertained, there are currently no directly applicable ASTM corrosion tests for phenolic foams. An attempt will be made to develop a meaningful corrosion test and will be incorporated into the standard when it becomes available. When it is anticipated that the foam will be in direct contact with metal, *the foam supplier shall provide the proper installation procedure.*

4.2 Acoustical Batts: When open rib acoustical deck is provided, sound absorbing acoustical glass fiber batts shall be installed in the field by the roofing contractor. Batts shall be shipped and stored at the jobsite in such a manner as to ensure protection until installation. If acoustical batts become wet, they shall be allowed to thoroughly dry without being compressed before installation.

4.3 Roof Coverings: A suitable roof covering shall be applied over the insulation.

4.4. Sheet Metal Work: All closures, flashing, etc., used in roof deck construction, unless otherwise specified, shall be detailed and furnished by the sheet metal contractor.

4.5 Field Painting: Any field painting or touch-up of abrasions or deterioration of the primer coat or other protective finishes shall be the responsibility of the buyer.

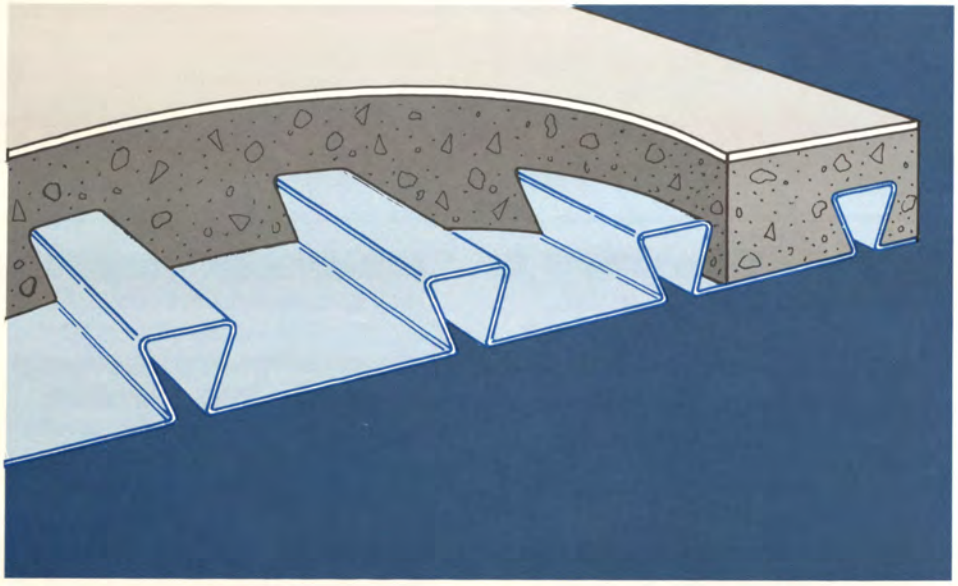
4.6. Shear Connectors: The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer.

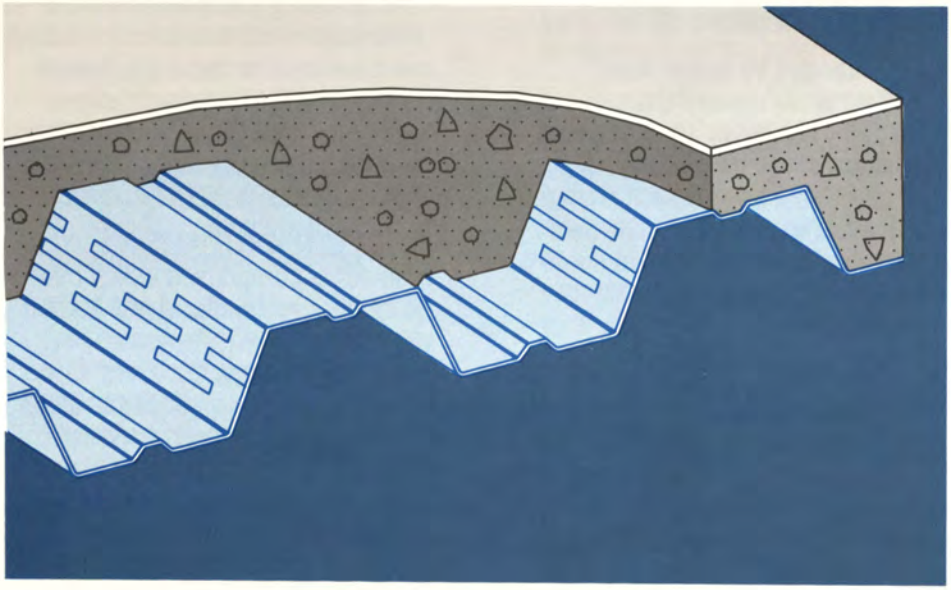
5. Construction Practice

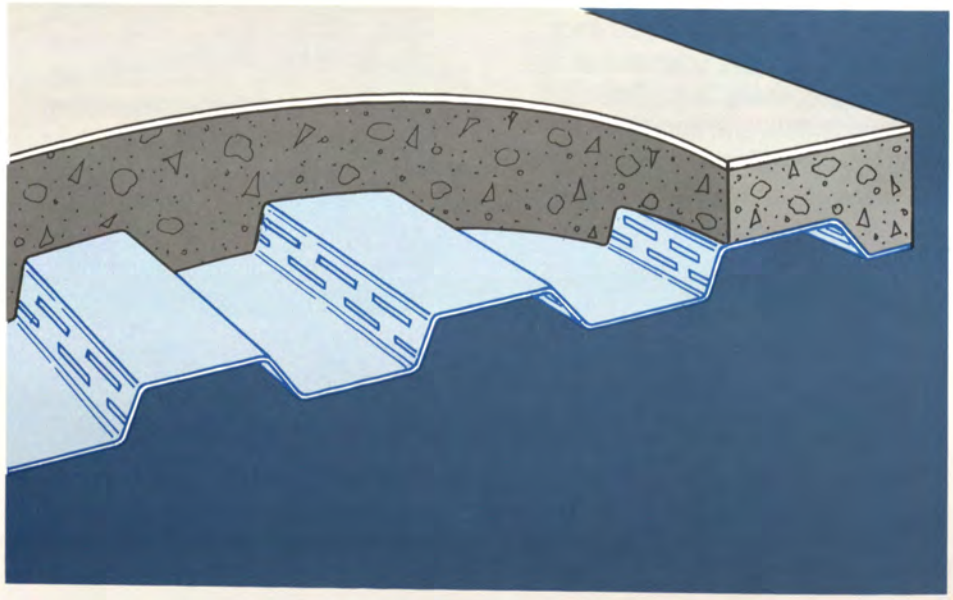
The Steel Deck Institute recommendations for site storage, installation, and construction practices are addressed specifically in the appropriate deck specifications in this design manual and are an integral part of this Code of Recommended Standard Practice.

Advantages

OF COMPOSITE STEEL FLOOR DECK







Composite Action: Steel floor decks, engineered for use in composite slab design, furnish positive reinforcement for the concrete slab and can eliminate the need for any additional positive reinforcing. Composite floor decks are designed to interlock positively with the overlying concrete fill, resulting in unit action. The interlocking process is achieved by mechanical means, deck profile and surface bond, or a combination.

Improved Composite Beam Construction: In a composite beam assembly, a composite floor slab and a steel beam are joined by shear connectors to create one structural unit which has greater strength than a separate slab and beam. Floor decks engineered for composite beam design simplify connector installations and enhance concrete coverage around shear connectors. In some cases, full AISC shear connector values and solid slab design can be applied.

Working Platform: Where many floor designs require temporary safety floors for tradesmen, floor deck with appropriate design and installation can be a safe working platform.

Permanent Forms: Steel floor decks eliminate the need for erection and removal of temporary forms.

Required Fire Ratings: UL fire resistance ratings for floor deck assemblies have been obtained by SDI manufacturers for their own products. Ratings are available for steel deck both with and without spray-applied fireproofing and with regular weight, lightweight, and semi-lightweight concrete.

SDI Specifications and Commentary

FOR COMPOSITE STEEL FLOOR DECK

1. Scope

This specification pertains to composite steel floor deck. Composite steel floor deck is cold formed steel deck which acts as a permanent form and as the positive bending reinforcement for the structural concrete. When suitably fastened, the steel deck also acts as a working platform for the various trades. After the concrete hardens, the steel deck and the concrete are interlocked by the shape of the deck, mechanical means, surface bond, or by a combination of these means.

2. Materials

2.1 Composite Steel Deck: Composite steel floor deck shall be fabricated from steel conforming to Section A3 of the latest edition (1986 and addenda), of the American Iron and Steel Institute, *Specification for the Design of Cold-Formed Steel Structural Members,* (AISI Specifications). The steel used shall have a minimum yield point of 33 ksi (230 MPa).

2.1a Tolerances:
Panel length: Plus or minus ½ inch (12 mm).
Thickness: Shall not be less than 95% of the design thickness.
Panel cover width: minus ⅜ inch (10 mm), plus ¾ inch (20 mm).
Panel camber and/or Sweep: ¼ inch in 10 foot length (6 mm in 3m).
Panel end out of square: ⅛ inch per foot of panel width (10 mm per m).

Commentary: Most composite steel floor deck is manufactured from steel conforming to ASTM Designation A611, Grades C and D or from A653-94, Structural Quality. If the published product literature does not show the uncoated steel thickness in decimal inches (or millimeters), but lists gage or type numbers, then the thickness of steel before coating with paint or metal shall be in conformance with the following table:

Type No.	Design Thickness		Minimum Thickness	
	In.	mm	In.	mm
22	0.0295	0.75	0.028	0.71
21	0.0329	0.84	0.031	0.79
20	0.0358	0.91	0.034	0.86
19	0.0418	1.06	0.040	1.01
18	0.0474	1.20	0.045	1.14
17	0.0538	1.37	0.051	1.30
16	0.0598	1.52	0.057	1.44

The tolerances reflect fabrication processes for steel deck products. Variation in cover width tolerances may vary due to trucking, storage or handling.

2.1b Finish: The finish on the steel composite deck shall be as specified by the designer and be suitable for the environment of the structure.

Commentary: Since the composite deck is the positive bending reinforcement for the slab, it must be designed to last the life of the structure; a minimum recommended finish is a galvanized coating as defined in ASTM A653-94, G60 (Z180).

2.2 Concrete: Concrete shall be in accordance with the applicable sections of chapters 3, 4 and 5 of the ACI 318 *Building Code Requirements for Reinforced Concrete.* Minimum compressive strength (f'c) shall be 3 ksi (20 MPa) or as required for fire ratings or durability. Admixtures containing chloride salts shall not be used.

Commentary: The use of admixtures containing chloride salts is not allowed because the salts may corrode the steel deck which has been designed as the slab reinforcement.

3. Design (Deck as a Form)

3.1 The section properties for the steel floor deck (as a form in bending) shall be computed in accordance with the AISI Specifications.

3.2 Bending stress in the deck shall not exceed 0.6 times the yield strength with a maximum of 36 ksi (250 MPa) under the combined loads of wet concrete, deck, and the following construction live loads: 20 pounds per square foot uniform load (1 kPa) or 150 pound concentrated load on a 1'0" wide section of deck (2.2 kN per m). **See Figure 1.**

Continued on next page

FOR COMPOSITE STEEL FLOOR DECK *Continued*

Commentary: The loading shown in Figure 1 is representative of the sequential loading of wet concrete on the form. The 150 pound load is the arithmetic result of 200 lb. (man's weight) × ¾. The philosophy here is to allow a ⅓ increase in stress due to the temporary nature of a man load. Decreasing the load by 25% is the mathematical equivalent of allowing a 33% increase in stress. Also the 150 pound load is considered to be applied in a one foot width but experience has shown that a greater distribution really occurs. For single span deck applications the ability to control the concrete placement may be restricted and a 1.5 factor has been applied to the concrete load to cover this condition. (The metric equivalent of the 150 pound load over a foot of width is 2.2 kN over a meter of width.)

3.3 Calculated theoretical deflections of the deck, as a form, shall be based on the load of the concrete (as determined by the design slab thickness) and the load from the steel deck, uniformly loaded on all spans, and shall be limited to L/180 or ¾ inch (20 mm), whichever is smaller. Deflections shall be relative to supporting members. **See Figure 2.**

Commentary: The deflection calculations do not take into account construction loads since these are considered as temporary loads. The deck is designed to always be in the elastic range so removal of temporary loads should allow the deck to recover. The structural steel also deflects under the loading of the wet concrete. The designer is urged to check the deflection of the total system especially if composite beams and girders are being used.

3.4 Minimum bearing lengths shall be determined in accordance with the AISI Specification; a uniform loading case of wet concrete, plus deck, plus 20 psf (1 kPa) construction load shall be used. **See Figure 3.**

Commentary: In the past, 1½ inches (40 mm) of end bearing was the minimum; this is still a good "rule of thumb" that will, in general, prevent slip off. If less than 1½ inches (40 mm) of end bearing is available, or if high support reactions are expected, then the designer should ask the deck manufacturer to check the deck web crippling strength. In any case, the deck must be adequately attached to the structure to prevent slip off.

4. Installation & Site Storage

4.1 Site Storage: Steel Deck shall be stored off the ground with one end elevated to provide drainage and shall be protected from the elements with a water-proof covering, ventilated to avoid condensation.

4.2 Deck Placement: Place each deck unit on supporting structural frame. Adjust to final position with accurately aligned side laps and ends bearing on supporting members.

Commentary: Staggering floor deck end joints is not a recommended practice. The deck capacity as a form and the load capacity of the composite deck/slab system are not increased by staggering the ends, yet layout and erection costs are increased.

4.3 Butted Ends: Deck sheets shall be butted over supports. Standard tolerance for ordered length is plus or minus ½ inch (12 mm).

Commentary: Lapping composite deck ends can be difficult because shear lugs (web embossment) or profile shape can prevent a tight metal to metal fit. The space between sheets can make welded attachments more difficult. Gaps are acceptable at butted ends. If taping of butted ends is requested, it is not the responsibility of the deck manufacturer.

4.4 Anchorage: Floor Deck units shall be anchored to supporting members including perimeter support steel and/or bearing walls by either welding or by mechanical fastening. This shall be done immediately after alignment. Deck units with spans greater than five feet (1.5 m) shall have side laps and perimeter edges (at perimeter support steel) fastened at midspan or 36 inch (1 m) intervals, whichever distance is smaller.

Commentary: This anchorage may be required to provide lateral stability to the top flange of the supporting structural members. The deck should be anchored to act as a working platform and to prevent blow off. Side iap fasteners can be welds, screws, crimps (button punching), or other methods approved by the designer. Welding side laps on thicknesses 0.028 inches (0.7 mm) or less may cause

large burn holes, and is not recommended. The objective of side lap fastening is to prevent differential sheet deflection during concrete placing and therefore prevent side joints from opening. The five foot (1.5 m) limit on side lap spacing is based on experience. The deck contractor should not leave unattached deck at the end of the day, as the wind may displace the sheets and cause injury to persons or property. The SDI *Diaphragm Design Manual, Second Edition,* should be used to determine fastening requirements if the deck will be designed to resist horizontal loads. The most stringent requirements, of either section 4.4 or, if applicable, the SDI *Diaphragm Design Manual,* should be used.

4.4a Welding: All welding of deck shall be in strict accordance with ANSI/AWS D1.3 *Structural Welding Code—Sheet Steel.* Each welder must demonstrate an ability to produce satisfactory welds using a procedure such as shown in the SDI *Manual of Construction with Steel Deck* or as described in ANSI/AWS D1.3. A minimum visible $\frac{5}{8}$ inch (15 mm) diameter puddle weld or equivalent is required at all edge ribs, plus a sufficient number of interior ribs to provide a maximum average spacing of 12 inches (300 mm). The maximum spacing between adjacent points of attachment shall not exceed 18 inches (460 mm). Fillet welds, when used, shall be at least 1 inch (25 mm) long. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members. Welding washers shall be used on all deck units with a metal thickness less than 0.028 inches (0.7 mm). Welding washers shall be a minimum thickness of 0.056 inches (1.5 mm, 16 gage) and have a nominal $\frac{3}{8}$ inch (10 mm) diameter hole.

Commentary: The welder may be qualified on plate or pipe under ANSI/AWS D1.1, *Structural Welding Code—Steel,* or under the provisions of other codes governing the welding of specific products, but may not be qualified for welding sheet steel. The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer. If studs are being applied through the deck onto structural steel, the stud welds can be used to replace the puddle welds. In general, stronger welds are obtained on 0.028 inches (0.7 mm) or thicker deck without weld washers. Welds on deck less than 0.028 inches (0.7 mm) are stronger with washers.

4.4b Mechanical Fasteners: Mechanical fasteners (powder-actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fasteners satisfies the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of unfastened ribs.

Commentary: The allowable load value per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than $\frac{1}{8}$ inch (3 mm) and on the fastener providing a $\frac{5}{16}$ inch (8 mm) diameter minimum bearing surface (fastener head size).

5. Design Deck and Concrete As A Composite Unit

5.1 General: The composite slab shall be designed as a reinforced concrete slab with the steel deck acting as the positive reinforcement. Slabs shall be designed as simple or continuous spans under uniform loads.

Commentary: High concentrated loads, diaphragm loads, etc. require additional analysis. Horizontal load capacities can be checked by referring to the SDI *Diaphragm Design Manual, Second Edition.*
Most published live load tables are based on simple span analysis of the composite system; that is, the slab is assumed to crack over each support. If the designer wants a continuous slab, then negative reinforcing should be designed using conventional reinforced concrete design techniques. The welded wire mesh, chosen for temperature reinforcing (Section 5.5), does not usually supply enough area for continuity. The deck is not considered to be compression reinforcing.

Continued on next page

FOR COMPOSITE STEEL FLOOR DECK *Continued*

Care should be used during the placement of loads on rolled-in hanger tabs for the support of ceilings so that approximate uniform loading is maintained. The individual manufacturer should be consulted for allowable loading on single rolled-in hanger tabs. Improper use of rolled-in hanger tabs could result in the overstressing of such tabs and/or the overloading of the composite deck slab.

5.2 Testing: The deck manufacturer shall have performed, under the supervision of a professional engineer, a sufficient number of tests on the composite deck slab system to have verified composite behavior. The tests shall have been performed on deck with a coating/finish that is acceptable for the application and as supplied. Based on the test information the design load rationale shall be established by: (1) elastic flexural analysis, (2) ultimate strength analysis.

5.2a Load Determination—Elastic Flexural Analysis. This method of load determination is to be used if there are no shear studs, or less than the minimum number of shear studs as required by the American Institute of Steel Construction (AISC) Specifications, on the beams perpendicular to the deck. Under the combined stresses caused by the superimposed (live) load and locked in form load, the tensile stress of the deck between permanent supports shall not exceed 0.60 times the yield strength of the steel or 36 ksi (250 MPa). The allowable load so determined may be increased by 10% if temperature and shrinkage reinforcement conforming to Section 5.5 of this specification is included in the system. Either allowable stress design (ASD) or load resistance factor design (LRFD) may be used to determine the load capacities.

5.2b Load Determination—Ultimate Strength Analysis. This method of load determination is to be used if there are shear studs on the beams perpendicular to the deck in sufficient quantity to meet the minimum requirements of the American Institute of Steel Construction (AISC) Specifications or, if tests on a particular deck profile have shown that the deck is capable of developing the full ultimate moment without shear studs. Using standard reinforced concrete design procedures the allowable superimposed load shall be found by using appropriate load resistance design (LRFD) factors to deduct the moment caused by the slab and deck weight from the calculated ultimate moment. Additional load reduction factors may be required if the number of shear studs used in the actual construction is less than needed to develop the ultimate capacity of the deck/slab. $Mn = 0.85\ As\ Fy\ (d - a/2)$, the ultimate moment, where As = steel deck area in square inches per foot of width (sq. mm per m); Fy = the steel yield strength (not to exceed 60 ksi, 415 MPa); d = the distance, inches (mm), from the top of the slab to the centroid of the steel deck; $a = AsFy/(0.85f'cb)$, inches (mm); and b is 12 inches (or 1 meter).

Commentary: By using one (or both) of the appropriate analysis techniques, the deck manufacturer determines the live loads that can be applied to the composite deck slab combination. The results are usually published as uniform load tables. The manufacturer may instead publish loads based on the results of a "shear bond" testing program and these loads would also be appropriate. For most applications, the deck thickness and profile is selected so that shoring is not required; the live load capacity of the composite system is usually more than adequate for the superimposed (live) loads. In calculating the section properties of the deck (under section 3.1 of these specifications), the AISI provisions may require that compression zones in the deck be reduced to an "effective width," but as tensile reinforcement, the total area of the cross section may be used. Coatings other than those tested may be investigated, and if there is evidence that their performance will be better than that of the tested product, additional testing may not be required. For example, it is well accepted that deck with light tight rust provides better shear bond than galvanized, therefore tested galvanized load capacities may be used for rusted decking.

5.3 Concrete: Concrete for composite slabs must be of structural quality as shown in ACI 318. Stresses in the concrete shall not exceed those allowed in ACI 318. However, if allowable stress design (ASD) is used, then the compressive stress in the concrete shall not exceed 0.45 f'c.

Commentary: Load tables are generally calculated by using a concrete strength of 3 ksi (20 MPa). Composite slab capacities are not greatly affected by variations in concrete strength; but, if the strength falls below 3 ksi (20 MPa), it would be advisable to check shear stud strengths. Fire rating requirements may dictate the minimum concrete strength.

5.3a Minimum Cover: The minimum concrete above the top of the floor deck shall be 2 inches (50 mm). When additional (negative bending) reinforcement is placed in the slab, the minimum cover of concrete above the reinforcing shall be ¾ inch (20 mm).

5.4 Deflection: Deflection of the composite slab shall not exceed L/360 under the superimposed load.

Commentary: Live load deflections are seldom a design factor. The deflection of the slab/deck combination can best be predicted by using the average of the cracked and uncracked moments of inertia as determined by the transformed section method of analysis.

5.5 Temperature and Shrinkage reinforcement, consisting of welded wire fabric or reinforcing bars, shall have a minimum area of 0.00075 times the area of concrete above the deck (per foot or per meter of width), but shall not be less than the area provided by 6 × 6-W1.4 × W1.4 welded wire fabric. For those products so manufactured, shear transfer wires welded to the top of the deck may be considered to act as shrinkage or temperature reinforcement.

Commentary: If welded wire mesh is used with a steel area given by the above formula, it will generally not be sufficient to be the total negative reinforcement; however, the mesh has shown that it does a good job of crack control especially if kept near the top of the slab (¾ inch to 1 inch cover, 20 to 25 mm).

6. Construction Practice

All deck sheets shall have adequate bearing and fastening to all supports so as not to lose support during construction. Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage. Damaged deck (sheets containing distortions or deformations caused by construction practices) shall be repaired, replaced, or shored to the satisfaction of the designer before placing concrete. The cost of repairing, replacing, or shoring of damaged units shall be the liability of the trade contractor responsible for the damage.

Commentary: For temporary construction loads prior to concrete placement, it should be safe to assume that the deck will support a minimum uniform load of 50 psf (2.4 MPa) without further investigation.

6.1 The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI code and shall be left in place until the slab attains 75% of it's specified compressive strength.

6.2 Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale and all other foreign matter.

6.3 Care must be exercised when placing concrete so that the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed from a low level to avoid impact, and in a uniform manner over the supporting structure and spread toward the center of the deck span. If buggies are used to place the concrete, runways shall be planked and the buggies shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck.Deck damage caused by roll bars or careless placement must be avoided.

Continued on next page

FOR COMPOSITE STEEL FLOOR DECK *Continued*

7. Additional Information and Comments

7.1 Parking Garages: Composite floor deck has been used successfully in many parking structures around the country; however, the following precautions should be observed:

1. slabs should be designed as continuous spans with negative bending reinforcing over the supports;

2. additional reinforcing should be included to deter cracking caused by large temperature differences and to provide load distribution; and,

3. in areas where salt water; either brought into the structure by cars in winter or carried by the wind in coastal areas, may deteriorate the deck, protective measures must be taken. The top surface of the slab must be effectively sealed so that the salt water cannot migrate through the slab to the steel deck. A minimum G90 (Z275) galvanizing is recommended, and, the exposed bottom surface of the deck should be protected with a durable paint.

The protective measures must be maintained for the life of the building. If the protective measures cannot be assured, the steel deck can be used as a stay in place form and the concrete can be reinforced with mesh or bars as required.

7.2 Cantilevers: When cantilevers are encountered, the deck acts only as a permanent form; top reinforcing steel must be proportioned by the designer.

7.3 Composite Beams and Girders: Most composite floor deck sections are suitable for use with composite beams. The AISC Specification specifically provides for the use of deck in this type of construction.

7.4 Fire Ratings: Many fire rated assemblies that use composite floor decks are available. Consult a SDI member manufacturer for a list of ratings.

7.5 Fireproofing: The metal deck manufacturer shall not be responsible for ensuring the bonding of fireproofing. The adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

7.6 Dynamic Loads: Dynamic loading, e.g., fork lifts, can, over a period of time, interfere with the mechanical bond between the concrete and deck which achieves its composite action via web indents. Reinforcing steel running perpendicular to the deck span and placed on top of the deck ribs is often used with this type of loading to distribute concentrated loads.

7.7 Other Criteria: Composite Steel floor deck may be used in a variety of ways, some of which do not lend themselves to a standard "steel deck" analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

FIGURE 1

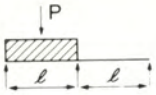
Loading Diagrams and Bending Moments

Simple Span Condition

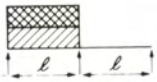
$+ M = .25P\ell + .188W1\ell^2$

$+ M = .125\,(1.5W1 + W2)\ell^2$

Double Span Condition



$+ M = .203P\ell + .096W1\ell^2$

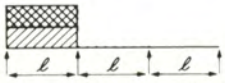


$+ M = .096\,(W1 + W2)\ell^2$

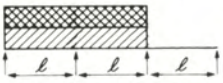
$- M = .125\,(W1 + W2)\ell^2$

Triple Span Condition

$+ M = .20P\ell + .094\,W1\ell^2$



$+ M = .094\,(W1 + W2)\ell^2$



$- M = .117\,(W1 + W2)\ell^2$

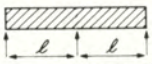
FIGURE 2

Loading Diagrams and Deflections

Simple Span Condition

$$\triangle = \frac{.0130W1\ell^4}{EI} \quad (1728)$$

Double Span Condition



$$\triangle = \frac{.0054W1\ell^4}{EI} \quad (1728)$$

Triple Span Condition

$$\triangle = \frac{.0069W1\ell^4}{EI} \quad (1728)$$

Note for Figures 1, 2 and 3

P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

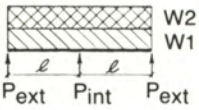
FIGURE 3

Loading Diagrams and Support Reactions

Simple Span Condition

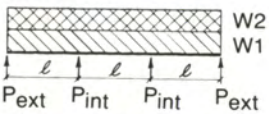
$P_{ext} = .5\,(W1 + W2)\ell$

Double Span Condition



$P_{ext} = .375\,(W1 + W2)\ell$
$P_{int} = 1.25\,(W1 + W2)\ell$

Triple Span Condition



$P_{ext} = .4\,(W1 + W2)\ell$
$P_{int} = 1.1\,(W1 + W2)\ell$

Composite Steel Floor Deck

DESIGN EXAMPLE

Given:

A. Bay Size = 26′ x 26′

B. Superimposed loads = 155 psf

C. Fire rating required = 2 hour

D. Concrete cover required on deck = 3¼″ lightweight

E. Composite beam construction.

F. Temporary shoring not desired.

1 Review deck manufacturer's literature for available deck types.

In shoring tables, choose deck that will not require temporary shoring during construction.

Check the allowable superimposed load tables for the required loading.

2 Review deck manufacturer's literature for combinations that meet requirements.

13′-0″ Beam Spacing

Embossed Deck: Formed and reinforced with 3″ × 0.0474″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement. Multi-span sheets require no temporary shoring.

8′-8″ Beam Spacing

Embossed Deck: Formed and reinforced with 2″ × 0.0358″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement.

6′-6″ Beam Spacing

Embossed Deck: Formed and reinforced with 1½″ × 0.0295″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement.

Note: For all the above, **no spray-applied fireproofing** of the deck is required for a 2-hour rating.

3 Factors that should be considered in selecting composite floor deck systems:

Compatibility of deck to total structure.

Hanging requirements.

Rib width-to-height ratio to determine stud values.

Compatibility of coating to stud welding.

Electrical requirements.

Future flexibility.

Deck material and erection costs. (Obtain from Steel Deck Institute member companies.)

Overall floor depth.

Cost of temporary shoring, if shored forming is selected.

Deck fireproofing cost, if protected deck is selected.

Concrete availability and cost: (lightweight) (semi-lightweight) (regular weight).

Concrete volume required.

Various beam spacings.

Total material cost.

Steel erection cost.

Steel fireproofing cost.

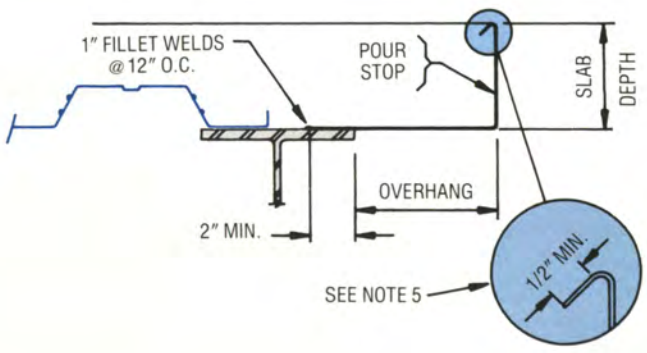
REVIEW OF PRODUCT LITERATURE SHOWS THAT 8′-8″ BEAM SPACING MEETS REQUIREMENTS MOST EFFICIENTLY.

SDI Pour Stop

SELECTION TABLE

SLAB DEPTH (Inches)	OVERHANG (INCHES)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
	POUR STOP TYPES												
4.00	20	20	20	20	18	18	16	14	12	12	12	10	10
4.25	20	20	20	18	18	16	16	14	12	12	12	10	10
4.50	20	20	20	18	18	16	16	14	12	12	12	10	10
4.75	20	20	18	18	16	16	14	14	12	12	10	10	10
5.00	20	20	18	18	16	16	14	14	12	12	10	10	
5.25	20	18	18	16	16	14	14	12	12	12	10	10	
5.50	20	18	18	16	16	14	14	12	12	12	10	10	
5.75	20	18	16	16	14	14	12	12	12	12	10	10	
6.00	18	18	16	16	14	14	12	12	12	10	10	10	
6.25	18	18	16	14	14	12	12	12	12	10	10		
6.50	18	16	16	14	14	12	12	12	12	10	10		
6.75	18	16	14	14	14	12	12	12	10	10	10		
7.00	16	16	14	14	12	12	12	12	10	10	10		
7.25	16	16	14	14	12	12	12	10	10	10			
7.50	16	14	14	12	12	12	12	10	10	10			
7.75	16	14	14	12	12	12	10	10	10	10			
8.00	14	14	12	12	12	12	10	10	10				
8.25	14	14	12	12	12	10	10	10	10				
8.50	14	12	12	12	12	10	10	10					
8.75	14	12	12	12	12	10	10	10					
9.00	14	12	12	12	10	10	10						
9.25	12	12	12	12	10	10	10						
9.50	12	12	12	10	10	10							
9.75	12	12	12	10	10	10							
10.00	12	12	10	10	10	10							
10.25	12	12	10	10	10								
10.50	12	12	10	10	10								
10.75	12	10	10	10									
11.00	12	10	10	10									
11.25	12	10	10										
11.50	10	10	10										
11.75	10	10											
12.00	10	10											

TYPES	DESIGN THICKNESS
20	0.0358
18	0.0474
16	0.0598
14	0.0747
12	0.1046
10	0.1345



NOTES: The above Selection Table is based on following criteria:

1. Normal weight concrete (150PCF).
2. Horizontal and vertical deflection is limited to 1/4" maximum for concrete dead load.
3. Design stress is limited to 20 KSI for concrete dead load temporarily increased by one-third for the construction live load of 20 PSF.
4. Pour Stop Selection Table does not consider the effect of the performance, deflection, or rotation of the pour stop support which may include both the supporting composite deck and/or the frame.
5. Vertical leg return lip is recommended for type 16 and lighter.
6. This selection is not meant to replace the judgement of experienced Structural Engineers and shall be considered as a reference only.

SDI reserves the right to change any information in this selection without notice.

SDI Specifications and Commentary

FOR NON-COMPOSITE STEEL FLOOR DECK

1. Scope

This specification and commentary pertains to the use of non-composite steel deck as a form for reinforced concrete slabs.

Commentary: This specification is not intended to cover highway bridges (where AASHTO specifications may govern), siding applications, or exposed roofs. In the past, most of the steel decking used in the manner that this specification covers, was referred to as "centering," however, various roof deck units have successfully been used as non-composite forms. The specification is intended to also include these applications.

2. Materials

2.1 Non-Composite Steel Form Deck: The steel deck units shall be manufactured from steel conforming to ASTM designation A611 Grades C, D, or E, or A653-94 Structural Quality with a minimum yield strength of 33 ksi (230 MPa). The unit design stress shall not exceed the yield strength multiplied by 0.60, with a maximum of 36 ksi (250 MPa).

Commentary: Most of the "centering" materials are offered in A653-94 grade 80 steel (galvanized) or ASTM A611 grade E (uncoated); this steel has a minimum yield strength of 80 ksi (550 MPa) and is generally over 90 ksi (620 MPa). In the past, 30 ksi (210 MPa) design stress was used for grade E material; however, the AISI specifications now allow a design stress of 36 ksi (250 MPa).

2.2 Tolerances:
Panel length: Plus or minus ½ inch (12 mm).
Thickness: Shall not be less than 95% of the design thickness.
Panel cover width: Minus ⅜ inch (10 mm), plus ¾ inch (20 mm).
Panel camber and/or sweep: ¼ inch in 10 foot length (6mm in 3m).
Panels end out of square: ⅛ inch per foot of panel width (10 mm per m).

Commentary: The above tolerances reflect fabrication practices for steel deck products. Cover width tolerances may vary due to trucking, storage, or handling.

Type (gage)	Design Thickness		Minimum Thickness	
	In.	mm	In.	mm
28	0.0149	0.38	0.014	0.35
26	0.0179	0.45	0.017	0.43
24	0.0238	0.60	0.023	0.57
22	0.0295	0.75	0.028	0.71
20	0.0358	0.91	0.034	0.86
18	0.0474	1.20	0.045	1.14
16	0.0598	1.52	0.057	1.44

Finishes available are:

1. Galvanized (Conforming to ASTM A924-94 and or ASTM A653-94);
2. Uncoated (Black);
3. Painted with a shop coat of primer paint (one or both sides).

The uncoated finish is, by custom, referred to as "black" by some users and manufacturers; the use of the word "black" does not refer to paint color on the product.

Centering materials are usually available galvanized or uncoated. When unshored galvanized material is used to support a reinforced concrete slab, the slab load is considered to be permanently carried by the deck. When uncoated or painted deck is used to support a reinforced concrete slab, the form is considered impermanent and the concrete load should be deducted from the load capacity of the reinforced slab.

For any permanent load carrying function, a minimum galvanized coating conforming to ASTM A653-94, G60 (Z180) is recommended.

3. Design

3.1 The section properties of the steel deck unit shall be computed in accordance with American Iron and Steel Institute, *Specification for the Design of Cold-Formed Steel Structural Members,* 1986 edition with addenda (AISI Specifications).

3.2 Deck used as a form for structural (reinforced) concrete slab:

3.2a Stress shall not exceed 0.60 times the yield strength, nor exceed 36 ksi (250 MPa) under the combined loads of wet concrete, deck, and the following construction live loads: 20 pounds per square foot (1kPa) uniform load or 150 pound concentrated load on a 1′-0″ wide section of deck (2.2 kN per m). **See Figure 1.**

Commentary: The construction loading is intended to simulate the sequence of concrete placement. For single span deck applications, the ability to control the concrete placement may be restricted; a 1.5 factor has been applied to the concrete load to cover this condition. The concrete placement contractor must be made aware of this loading criteria and take care not to exceed them.

3.2b Calculated form deflection shall be based on the load of the wet concrete (as determined by the design slab thickness) and the steel deck, uniformly loaded on all spans, and shall be limited to L/180 or ¾ inch (20 mm), whichever is smaller. Deflection shall be relative to supporting members. **See Figure 2.**

Commentary: The deflection limits of L/180 and ¾ inches (20 mm) are intended to be minimum requirements. Architectural or other considerations may influence the designer to use a more stringent limit.

3.2c The minimum bearing lengths shall be determined in accordance with the AISI Specification; the uniform loading case of wet concrete plus deck plus 20 pounds per square foot (1kPa) construction load shall be used. Minimum bearing shall be 1½ inches (40 mm) unless otherwise shown.

Commentary: Form decks made of grade E steel may have a radius to thickness ratio not covered by the AISI Specification. Experience has shown that 1½ inches (40 mm) of bearing is sufficient for these decks. If less than 1½ inches (40 mm) is available for any form deck, or if high support reactions are expected, the designer should ask the deck manufacturer to check the deck web crippling capacity. In any case, the deck must be adequately attached to the structure to prevent slip off.

3.2d Design of the concrete slabs shall be done in accordance with the ACI 318 Building Code. The concrete cover over the top of the deck shall not be less than 1½ inches (40 mm). Randomly distributed fibers or fibrous add mixes shall not be substituted for welded wire fabric tensile reinforcement.

Commentary: In following the ACI 318 requirements for temperature reinforcement, the designer may eliminate the concrete area that is displaced by the deck ribs. For slabs with total depth of 3 inches (75 mm) or less, the reinforcing mesh may be considered to be at the center of the concrete above the deck. **See Figure 3.** If uncoated or painted deck is used as the form, the load of the concrete slab must be deducted from the calculated capacity of the reinforced concrete slab. If galvanized form is used, the load of the slab is considered to be permanently carried by the deck and need not be deducted from the live load. If temporary shoring is used, the load of the slab must be deducted from the calculated capacity of the reinforced slab regardless of the deck finish.

Except for some diaphragm values, the deck should not be assumed to act compositely with the concrete even though strong chemical bonds can, and do, develop.

4. Installation & Site Storage

4.1 Site Storage: Steel Deck shall be stored off the ground with one end elevated to provide drainage and shall be protected from the elements with a waterproof covering, ventilated to avoid condensation.

4.2 Deck Placement: Place each deck unit on the supporting structural frame. Adjust to final position with accurately aligned side laps and ends bearing on supporting members and attach immediately. On joist framing, be sure the appropriate end joint occurs over a top chord angle for proper anchorage.

Commentary: Staggering deck ends is not a recommended practice. The deck capacity as a form and the load capacity of the non-composite deck/slab system are not increased by staggering the end joints, yet layout and erection costs are increased.

Continued on next page

FOR NON-COMPOSITE STEEL FLOOR DECK

Continued

4.3 Lapped or Butted Ends: Deck ends may be either butted or lapped over supports.

Commentary: Gaps are acceptable at butted ends. If taping of butted ends is requested, it is not the responsibility of the deck manufacturer.

4.4 Anchorage: Floor deck units shall be anchored to supporting members including perimeter support steel and/or bearing walls by either welding or by mechanical fastening. This shall be done immediately after alignment. Deck units with spans greater than five feet (1.5 m) shall have side laps and perimeter edges (at perimeter support steel) fastened at midspan or 36 inch (1 m) intervals—whichever is smaller.

Commentary: This anchorage may be required to provide lateral stability to the top flange of the supporting structural members.

The deck should be anchored to act as a working platform and to prevent blow off. The frame fastening shown in figure 4 and the side lap fastening of 4.4 ARE MINIMUM REQUIREMENTS. In no case should fasteners to the supports be spaced greater than 36 inches (1 m) on center. The SDI *Diaphragm Design Manual, Second Edition,* should be used to determine fastening requirements when the deck is designed to resist horizontal loads. The most stringent fastening requirements, of this specification or, if applicable, the SDI *Diaphragm Design Manual, Second Edition* should be used. Side lap fasteners can be welds, screws, crimps (button punching), or other methods approved by the designer. Welding side laps on thickness less than 0.028 inches (0.7 mm) may cause large burn holes, and is not recommended. The objective of side lap fastening is to prevent differential sheet deflection during concrete loading, therefore preventing side joints from opening. The five foot (1.5 m) limit on side lap spacing is based on experience.

The deck contractor should not leave unattached deck at the end of the day as the wind may displace the sheets and cause injury to persons or property. If studs are being welded to the top flange of the beams, deck sheets should be butted over the supports.

4.4a Welding: All welding of deck shall be in strict accordance with ANSI/AWS D1.3, *Structural Welding Code—Sheet Steel.* Each welder must demonstrate an ability to produce satisfactory welds using a procedure such as shown in the SDI *Manual of Construction with Steel Deck,* or as described in ANSI/AWS D1.3. Welding washers shall be used on all deck units with metal thickness less than 0.028 inches (0.7 mm). Welding washers shall be a minimum thickness of 0.0598 inches (16 gage, 1.50 mm) and have a nominal $\frac{3}{8}$ inch (12 mm) diameter hole. Where welding washers are not used, a minimum visible $\frac{5}{8}$ inch (15 mm) diameter arc puddle weld shall be used. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members. When used, fillet welds shall be at least 1 inch (25 mm) long.

Commentary: The welder may be qualified under ANSI/AWS D1.1, *Structural Welding Code—Steel,* or under the provisions of other codes governing the welding of specific products, but may not be qualified for welding sheet steel. In general, stronger welds are obtained on 0.028 inches (0.7 mm) or thicker deck without weld washers. Welds on deck less than 0.028 inches (0.7 mm) are stronger with washers. The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer. If studs are being applied through the deck onto structural steel, the stud welds can be used to replace the puddle welds.

4.4b Mechanical Fasteners: Mechanical fasteners (powder-actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fasteners satisfy the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of any unfastened ribs.

Commentary: The allowable load value per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than $\frac{1}{8}$ inch (3 mm) and on the fastener providing a $\frac{5}{16}$ inch (8 mm) diameter minimum bearing surface (fastener head size).

4.5 Construction Practice

4.5a All deck sheets shall have adequate bearing and fastening to all supports so as not to lose support during construction. Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage. Damaged deck (sheets containing distortions or deformations caused by construction practices) shall be repaired, replaced, or shored to the satisfaction of the designer before placing concrete. The cost of repairing, replacing, or shoring of damaged units shall be the liability of the trade contractor responsible for the damage.

Commentary: For temporary construction loads prior to concrete placement, it should be safe to assume that the deck will support a minimum uniform load of 50 psf (2.4 kPa) without further investigation.

4.5b The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI code and shall be left in place until the slab attains 75% of its specified compressive strength.

4.5c Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale and all other foreign matter.

4.5d Care must be exercised when placing concrete so the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed from a low level to avoid impact, in a uniform manner, over the supporting structure and spread toward the center of the deck span. If buggies are used to place the concrete, runways shall be planked and the buggies shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

4.6 Information:

Commentary: Fire ratings, diaphragm design information and reinforced concrete slab capacities are available from most SDI form deck manufacturers.

Steel form deck may be used in a variety of ways, some of which do not lend themselves to a standard "steel deck" analysis for span and loading. In these cases there are other criteria which must be considered besides those given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable codes and that any special conditions are included in the design.

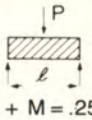
4.7 Fireproofing: The metal deck manufacturer shall not be responsible for ensuring the bonding of fireproofing. Adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

SDI Specifications and Commentary

FIGURE 1

Loading Diagrams and Bending Moments

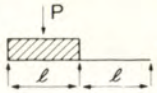
Simple Span Condition



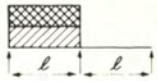
$+ M = .25P\ell + .188W1\ell^2$

$+ M = .125(1.5W1 + W2)\ell^2$

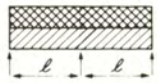
Double Span Condition



$+ M = .203P\ell + .096W1\ell^2$



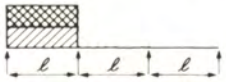
$+ M = .096(W1 + W2)\ell^2$



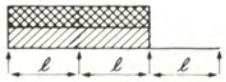
$- M = .125(W1 + W2)\ell^2$

Triple Span Condition

$+ M = .20P\ell + .094W1\ell^2$



$+ M = .094(W1 + W2)\ell^2$



$- M = .117(W1 + W2)\ell^2$

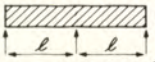
FIGURE 2

Loading Diagrams and Deflections

Simple Span Condition

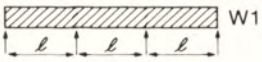
$$\triangle = \frac{.0130W1\ell^4}{EI} \quad (1728)$$

Double Span Condition



$$\triangle = \frac{.0054W1\ell^4}{EI} \quad (1728)$$

Triple Span Condition



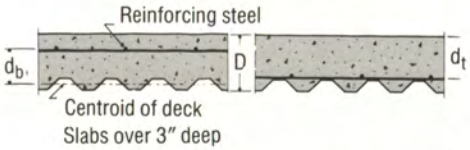
$$\triangle = \frac{.0069W1\ell^4}{EI} \quad (1728)$$

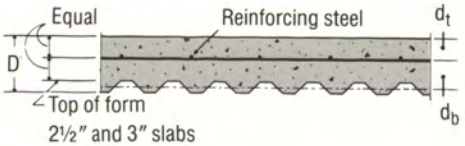
Note for Figures 1, 2 and 3

P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

FIGURE 3

Form Deck Typical Slabs



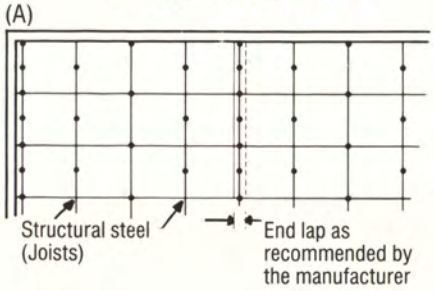


D = Depth of Slab
d_t = Distance from reinforcing steel to top of concrete
d_b = Distance from reinforcing steel to centroid of deck

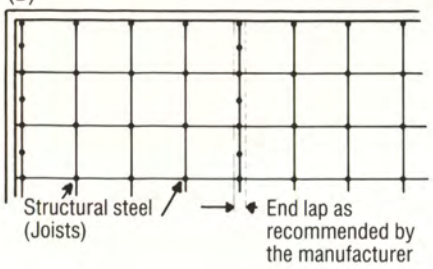
FIGURE 4

Minimum Fastening Patterns

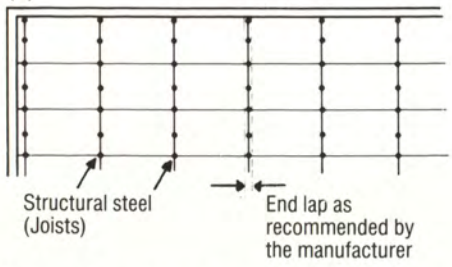
(A)



(B)



(C)



Intermediate side lap attachments not shown. See Section 4.4 Anchorage non-composite steel form deck.

Note:
Fastener patterns A and B are for deck spans up to 4′6″. Fastener pattern C is for deck spans from 4′6″ to 8′0″. If spans exceed 8′0″, fastener should be placed so that the average spacing (at supports) is not more than 12″.

Non-Composite Steel Form Deck

DESIGN EXAMPLE

1. Deck is to be used as a permanent form for a reinforced concrete slab. Specify the form section properties based on the following conditions:

1.1 Concrete slab is 4″ total thickness—150 pcf concrete.

1.2 Deck to be used is nominal 1⅜″ deep, grade E steel conforming to ASTM-A446 (galvanized)

$f_y = 80{,}000$ psi

$f = 36{,}000$ psi

1.3 Joists at 5′-0″ o.c. with 3″ flange width (clear span = 4.75 ft.). All sheets of deck can span three or more supports.

1.4 For architectural considerations, the wet load deflection is to be limited to L/240 of the span.

2. Construction Loads
(to find concrete weight, consult manufacturer's catalog).

Concrete weight (typical)	43 psf
Deck weight (estimated)	2 psf
Total wet load (W_1)	45 psf

3. Negative Bending

$-M = .117\,(W_1 + W_2)\,\ell^2\,(12) =$
$.117\,(45 + 20)\,(4.75)^2\,(12)$

$-M = 2059$ in. lbs.

4. Positive Bending

$+M = [0.20\,P\ell + .094\,W_1\ell^2]\,12$

$+M = [0.20 \times 150 \times 4.75 +$
$0.094 \times 45 \times (4.75)^2]\,12$

$+M = 2855$ in. lbs.

5. Section Moduli

$-S$ (required) =
$2059/36{,}000 = 0.057$ in.^{3}

$+S$ (required) =
$2855/36{,}000 = 0.079$ in.^{3}

6. Calculate Required I.

$\Delta = \ell/240 = 4.75 \times 12/240 =$
0.2375 in.

$$\Delta = \frac{0.0069 W_1 \ell^4 (1728)}{EI}$$

$$I = \frac{.0069\,(45)\,(4.75)^4\,1728}{29.5 \times 10^6 \times .2375}$$

I (required) $= 0.039$ in.^{4}

7. Summary.
Designer should specify deck based on these properties or specify the performance requirements.

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION

PART 1—GENERAL

1.1 Summary

The requirements of this Specification Section include all materials, equipment and labor necessary to furnish and install Cellular Deck that is used as a component of an in-floor distribution system for electrical-type services. The complete system shall be referred to as a Cellular Floor System. Included in the System shall be Cellular Deck, alternating Non-Cellular Deck and related components for in-floor distribution of electrical-type services.

Commentary: A Cellular Floor System is always contained within the depth of a building's floor slabs. In this manner, it may be used as an integral part of a concrete slab supported by structural members or, as part of a slab supported by an underlying concrete slab. The underlying concrete slab may be a slab on grade. These are commonly referred to as a "mud" slabs.

A. Cellular Deck shall serve as composite or non-composite type floor deck and/or as a raceway for the in-floor distribution for electrical-type services.

B. A Cellular Floor System shall include all Cellular Deck units or an alternating combination of Cellular and Non-Cellular Deck units as indicated on the design drawings.

Commentary: Systems are commonly referred to as "full cellular" when they include all Cellular Deck units, and "blended" when they include an alternating combination of Cellular and Non-Cellular units.

C. In order to provide a complete in-floor distribution system for electrical-type services, specialized components for this purpose shall be available. These components shall be referred to as compatible electrical components and shall be furnished under this Specification Section for installation by the electrical contractor. Compatible electrical components to be furnished may include: preset inserts, activation kits, afterset inserts, service fittings, header ducts and trench header ducts.

Commentary: Unlike Cellular Deck, compatible electrical components are not structural items. However, it is generally advantageous that compatible electrical components be furnished under the same Specification Section as the Cellular Deck. This is because components produced by one manufacturer to be compatible with its Cellular Deck may not be compatible with Cellular Deck produced by another manufacturer.

1.2 Related Sections

Work that is related to, but not part of, this Specification Section may be included in the following sections:

A. Cast-In-Place Concrete: concrete fill, welded wire fabric, reinforcing steel and temporary shoring.

B. Structural Steel: supporting members and shear studs.

C. Fireproofing: preparation of deck surfaces for application of fireproofing materials.

D. Electrical: wires, cables, power receptacles, voice and signal connectors, underfloor duct, and all electrical raceway components located above the finished floor slab.

1.3 Submittals

In accordance with applicable requirements of the contract documents, submit the following for approval:

A. Product data for all components of the Cellular Floor System including material types, dimensions, finishes, load capacities, fire resistance ratings and electrical approvals.

B. Erection drawings and installation instructions for all components of the Cellular Floor System including profiles and material thicknesses, layout, anchorage, openings as dimensioned on the design drawings, and shoring requirements.

1.4 Quality Assurance

A. Section Properties: Shall be computed in accordance with the latest edition (1986 and Addenda) of the AISI *Specification for the Design of Cold-Formed Steel Structural Members.*

B. Welding: Shall comply with applicable provisions of ANSI/AWS D1.3-89 *Structural Welding Code—Sheet Steel.*

C. **Cast-In-Place Concrete:** Shall be provided in accordance with applicable sections of chapters 3, 4 and 5 of ACI 318 Building Code Requirement for Reinforced Concrete. Minimum compressive strength shall be 3 ksi (20 MPa). Admixtures containing chloride salts shall not be used.

D. **Fire Resistance Classification:** Shall be provided in accordance with an Underwriters Laboratories Fire Resistance Design Number as indicated on the design drawings. All components of the Cellular Floor System used in rated fire resistance designs shall bear the appropriate UL classification marking.

E. **Electrical Requirements:** Shall comply with applicable provisions of Article 356 of the *National Electric Code* and UL Standard for Safety No. 209. The manufacturer shall be listed in Underwriters Laboratories Electrical Construction Materials Directory under the category *Cellular Metal Floor.*

F. **General Requirements:** Shall be in accordance with all applicable provisions of the Steel Deck Institute.

1.5 Delivery, Storage and Handling

All components of the Cellular Floor System shall be protected from significant damage during shipment and handling. If storage at the jobsite is required, bundles or packages of these materials shall be elevated above the ground, sloped to provide drainage and protected from the elements with a ventilated waterproof covering.

PART 2—PRODUCTS

2.1 Materials

A. Cellular and alternating Non-Cellular Deck units shall be cold-formed from steel sheets conforming to ASTM A653-94 Structural Quality with a minimum yield strength of 33 ksi (230 Mpa).

B. Before forming, the steel sheets shall have received a hot-dip protective coating of zinc conforming to ASTM A924-94 with a minimum coating class of G60 (Z180) as defined in ASTM A653-94.

C. The minimum uncoated thickness of materials furnished shall not be less than 95% of the design thickness.

2.2 Fabrication

A. Cellular Deck units shall be fabricated by welding a fluted top "hat" section to a bottom "plate" section. The combination of these sections shall form "cells" that may be utilized as raceways for electrical-type services.

B. Design thickness, minimum section properties and configuration of the Cellular and alternating Non-Cellular Deck units shall be indicated on the design drawings.

C. Cellular and alternating Non-Cellular Deck units shall be fabricated to provide a minimum three span condition whenever possible.

D. Factory made openings in the top "hat" sections of Cellular Deck units shall be provided at preset insert locations and at typical intersections with header ducts or trench header ducts as indicated on the design drawings.

2.3 Design

Cellular and alternating Non-Cellular Deck units that are used as components of a Cellular Floor System shall be analyzed for special design requirements that could affect the structural performance of these units.

A. Composite action shall not be considered to be provided by Cellular and alternating Non-Cellular Deck units that are used at spans where trench header ducts are located. Deck units used at these spans shall be designed to carry the entire required dead and live loads independent of concrete fill.

Commentary: Reference examples (page 28) to illustrate the design of floor deck units at spans where trenches are located for one, two and three span conditions.

B. The section properties of Cellular Deck units that are used as part of an alternating blend of no more than one Cellular Deck unit to one Non-Cellular Deck unit may be prorated with those of the blended Non-Cellular Deck units.

Commentary: Reference example (page 29) to illustrate prorating of section properties.

C. The superimposed load capacities of composite Cellular Deck slabs that are used as part of an alternating blend of no more than one Cellular Deck unit to one Non-Cellular Deck unit may be prorated with those of the composite Non-Cellular Deck slab.

Continued on next page

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION *Continued*

2.4 Accessories

A. Column closures, end closures and side closures shall be provided per manufacturer's standards.

B. Slab edge forms of 10 gage or less material thickness shall be provided as indicated on the design drawings.

C. Appropriate grounding plates shall be provided for Cellular Deck units that are supported by underlying concrete slabs.

2.5 Compatible Electrical Components

A. Preset Inserts: Provide manufacturer's standard Preset Inserts at locations as indicated on the design drawings.

Commentary: Preset Inserts are box-like units that are installed on the Cellular Deck over factory made openings before concrete is poured. After pouring, the Preset Inserts will be covered by a shallow layer of concrete. When access to underlying cells is required, the concrete covering at a Preset Insert is removed and an assembly of compatible parts known as an Activation Kit is then installed at this location.

B. Activation Kits: Provide manufacturer's standard Activation Kits at Preset Insert locations as indicated on the design drawings and/or in designated numbers.

Commentary: A "standard" Activation Kit usually indicates one that allows electrical-type service devices to be located inside the Preset Insert and beneath the finished floor covering. Other types of Activation Kits such as those that allow pre-wired partitions to be directly connected to Preset Inserts are generally available. Specific functions and/or appearances required of the Activation Kits should be indicated on the design drawings.

C. Afterset Inserts: Provide designated numbers of manufacturer's standard Afterset Inserts.

Commentary: Afterset Inserts are sleeve-like units that are installed on the Cellular Deck after concrete is poured. When access to underlying cells is required, a hole is field drilled into the concrete fill at a location along the length of a cell or group of cells. The Afterset Insert and an assembly of compatible parts known as a Service Fitting is then installed at this location.

D. Service Fittings: Provide manufacturer's standard Service Fittings in designated numbers.

Commentary: A "standard" Service Fitting usually indicates one that allows electrical-type service devices to be located inside a "monument" and above the finished floor covering. Other types of Service Fittings such as those that allow service devices to be located inside the Afterset Insert and beneath the finished floor covering are generally available. Specific functions and/or appearances required of the Service Fittings should be indicated on the design drawings.

E. Header Ducts and Trench Header Ducts: Provide manufacturer's standard Header Ducts and/or Trench Header Ducts at locations as indicated on the design drawings. Width, depth and compartment configuration shall be indicated on the design drawings.

Commentary: Header Ducts and Trench Header Ducts are trough-like units that distribute wires and cables for electrical-type services to groups of Cellular Deck units from a point of origin located near a service panel. Both types are installed on Cellular Deck over factory made typical openings before concrete is poured. After pouring, Header Ducts will be covered by a shallow layer of concrete except at intermittently located access hatches. Continuously located removable cover plates provide access into Trench Header Ducts.

PART 3—EXECUTION

3.1 Examination

A. Before installation begins, supporting members and/or underlying concrete slabs shall be examined and accepted for installation of a Cellular Floor System.

3.2 Installation

The Cellular Floor System shall be installed in strict accordance with the manufacturer's approved erection drawings and all applicable safety regulations. Raceways shall not be penetrated by fasteners with sharp points or edges that could damage wires or cables.

Commentary: Cellular and alternating Non-Cellular Deck units that are supported by structural members are generally installed by the structural steel erector. Compatible electrical components are generally installed by the electrical contractor as are Cellular Deck units when they are supported by an underlying concrete slab.

A. Bundles or packages of Cellular Floor System components shall be placed on supporting members in such a manner that overloading of any of the individual framing members does not occur. Components shall not be placed on underlying concrete slabs until after the slabs have adequately cured.

B. Before being permanently fastened, Cellular and alternating Non-Cellular Deck units shall be placed with accurate alignment and proper end bearing on supporting members or underlying concrete slabs.

Commentary: Cellular Deck units are required to interface with compatible electrical components. For this reason, they must be located with a greater degree of accuracy than is customary for Non-Cellular Deck units. Strict compliance with the manufacturer's erection drawings is essential when installing Cellular Deck for a Cellular Floor System.

C. Immediately after alignment is completed, Cellular and alternating Non-Cellular Deck units shall be fastened to supporting members or underlying concrete slabs as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

D. After fastening to supporting members is completed, Cellular and alternating Non-Cellular Deck units shall be fastened at sidelaps and perimeter edges (sides located at perimeter supporting members) as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

E. Column closures, end closures, side closures and furnished slab edge forms shall be fastened as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

3.3 After Installation

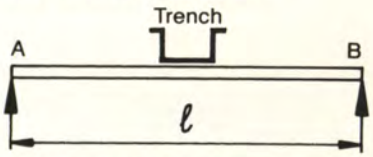
A. Procedures for cutting, reinforcement, protection, repair, top surface cleaning, temporary shoring and concrete placement shall comply with applicable SDI requirements for floor deck installation.

B. Cellular and alternating Non-Cellular Deck units shall be examined by the electrical contractor and accepted for installation of compatible electrical components. The electrical contractor shall furnish and install tape for butt joints of Cellular Deck units and install Cellular Deck units that are supported by underlying concrete slabs.

C. Concrete shall be hand finished along both sides of trench header ducts. No traffic shall be permitted on trench header ducts until after adjacent concrete has adequately cured and installation of cover plate supports is complete.

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION *Continued*

Steel deck single span.

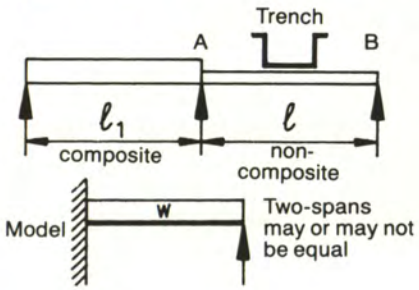


Design steel deck for:

$$+M = \frac{(W_D + W_L)\,\ell^2}{8}$$

$$\Delta = \frac{.013\,W_L\,\ell^4\,1728}{EI} \leqq \frac{\ell \times 12}{360}$$

Steel deck two span—or the trench is in the end span of three (or more) span deck.



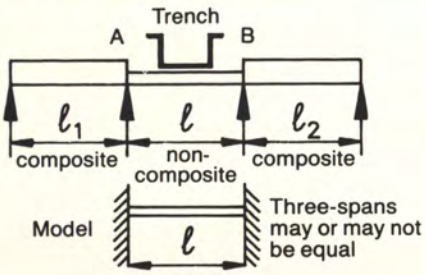
Design steel deck for:

$$-M = (W_D + W_L)\,\ell^2/8$$

$$+M = 9\,(W_L + W_D)\,\ell^2/128$$

$$\Delta = \frac{W_L\ell^4\,1728}{185\,EI} \leqq \frac{\ell \times 12}{360}$$

Steel deck three (or more) span—trench is in interior span.



Design steel deck for:

$$+M = (W_D + W_L)\,\ell^2/24$$

$$-M = (W_L + W_D)\,\ell^2/12$$

$$\Delta = \frac{W_L\,\ell^4\,1728}{384\,EI} \leqq \frac{\ell \times 12}{360}$$

If sufficient negative bending reinforcing is used at supports (A and B) then the steel deck may need to be only designed to carry the form load as the concrete cantilever slab could be designed for live loads.

Commentary: In all of the above equations:

ℓ is the non-composite span, ft.

W_L is the live load, psf

W_D is the dead load, psf

I is the I of the steel deck alone, in^4

In most cases these formulas will provide conservative answers. For instance, in case 3, if true composite I values are used in ℓ_1 and ℓ_2 and the I of the deck is used in ℓ, then moments at A and B will reduce; an analysis based on this approach would be acceptable. It is also generally conservative to use the concrete weight instead of the actual weight of the trench for dead load on form load.

EXAMPLE OF PRORATING SECTION PROPERTIES

For a blended system alternating one fluted and one cellular deck unit.

Blended System 60% Fluted; 40% Cellular

Fluted: I = 1.00; Sp = 0.55; Sn = 0.60

Cellular: I = 1.55; Sp = 0.65; Sn = 0.68

Prorated:
I = 0.6 x 1 + 0.4 x 1.55 = 1.22 in.⁴/ft.
Sp = 0.6 x 0.55 + 0.4 x 0.65 = 0.59 in.³/ft.
Sn = 0.6 x 0.60 + 0.4 x 0.68 = 0.63 in.³/ft.

FIGURE 1

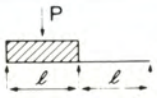
Loading Diagrams and Bending Moments

Simple Span Condition

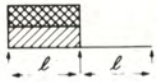
$+ M = .25P\ell + .188W1\ell^2$

$+ M = .125\,(1.5W1 + W2)\ell^2$

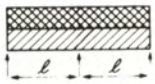
Double Span Condition



$+ M = .203P\ell + .096W1\ell^2$

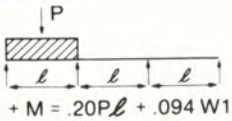


$+ M = .096\,(W1 + W2)\ell^2$

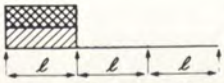


$- M = .125\,(W1 + W2)\ell^2$

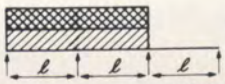
Triple Span Condition



$+ M = .20P\ell + .094\,W1\ell^2$



$+ M = .094\,(W1 + W2)\ell^2$



$- M = .117\,(W1 + W2)\ell^2$

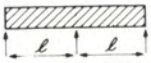
FIGURE 2

Loading Diagrams and Deflections

Simple Span Condition

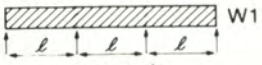
$$\Delta = \frac{.0130W1\ell^4}{EI} \quad (1728)$$

Double Span Condition



$$\Delta = \frac{.0054W1\ell^4}{EI} \quad (1728)$$

Triple Span Condition



$$\Delta = \frac{.0069W1\ell^4}{EI} \quad (1728)$$

Note for Figures 1, 2 and 3

P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

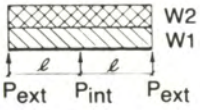
FIGURE 3

Loading Diagrams and Support Reactions

Simple Span Condition

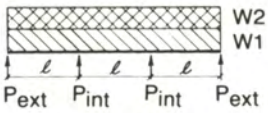
$P_{ext} = .5\,(W1 + W2)\ell$

Double Span Condition



$P_{ext} = .375\,(W1 + W2)\ell$
$P_{int} = 1.25\,(W1 + W2)\ell$

Triple Span Condition



$P_{ext} = .4\,(W1 + W2)\ell$
$P_{int} = 1.1\,(W1 + W2)\ell$

Continued on next page

SDI Specifications and Commentary

FOR STEEL ROOF DECK

1. Scope

The requirements of this section shall govern only ribbed steel roof deck construction of varying configurations used for the support of roofing materials, design live loads and SDI construction loads shown on page 31.

Commentary: Suspended ceilings, light fixtures, ducts, or other utilities shall not be supported by the steel deck.

2. Materials

2.1 Steel Roof Deck: The steel roof deck units shall be fabricated from steel conforming to Section A3 of the latest edition, (1986) of the American Iron and Steel Institute, Specifications for the Design of Cold-Formed Steel Structural Members. The steel used shall have a minimum yield strength of 33 ksi (230 MPa).

2.2 Tolerances:
Panel length: Plus or minus ½ inch (13 mm).
Thickness: Shall not be less than 95% of the design thickness.
Panel cover width: Minus ⅜ inch (10 mm), plus ¾ inch (20 mm).
Panel camber and/or sweep: ¼ inch in 10 foot length (6 mm in 3 meters).
Panel end out of square: ⅛ inch per foot (3 mm in 300 mm) of panel width.

Commentary: The above tolerances reflect the fabrication processes for steel deck products. Variation in cover width tolerances may vary due to trucking, storage, handling.

The steel roof deck shall be manufactured from steel conforming to ASTM Designation A611, Grades C, D or E or from A653-94 Structural Quality grade 33 or higher. If the published product literature does not show the uncoated steel thickness in decimal inches (or millimeters) but lists gage or type numbers, then the thickness of steel before coating with paint or metal shall be in conformance with the following table:

Type No.	Design Thickness		Minimum Thickness	
	In.	mm	In.	mm
22	0.0295	0.75	0.028	0.70
20	0.0358	0.90	0.034	0.85
18	0.0474	1.20	0.045	1.15
16	0.0598	1.50	0.057	1.45

3. Design

3.1 Stress: The maximum working stress shall not exceed 20 ksi (140 MPa). The unit design stress shall in no case exceed the minimum yield strength of the steel divided by 1.65 for specific design uniform loads. The unit design stress shall be increased 33% for temporary concentrated loads provided the deck thus required is no less than that required for the specific design uniform loads.

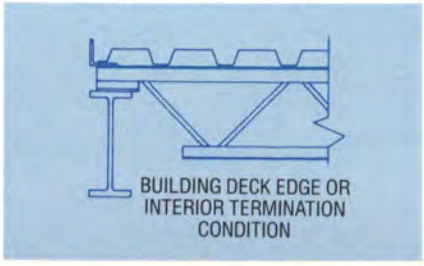
3.2 Section Properties: Structural properties of roof deck sections shall be computed in accordance with the American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members, 1986 edition and Addenda.

Commentary: Arbitrarily assumed effective compression flange widths shall not be allowed. Testing shall not be used in lieu of the above in determination of vertical load carrying capacity of steel deck.

3.3 Moment and Deflection Coefficients: A moment coefficient of ⅛ shall be used for simple and dual equal spans and a moment coefficient of 1/10 shall be used for 3 or more equal spans. Deflection coefficients shall be .013 for simple spans, 0.0054 for double spans and 0.0069 for triple spans.

3.4 Maximum Deflections: Deflection of the deck shall not exceed L/240 under the uniformly distributed design live load. All spans are to be considered center-to-center of supports.

Commentary: The adequacy of deck edge support details should be reviewed. At the building perimeter, or any other deck termination or direction change, occasional concentrated loading of the roof deck could result in temporary differences in deflection between the roof deck and the adjacent stationary building component. Supplemental support such as a perimeter angle may be warranted.

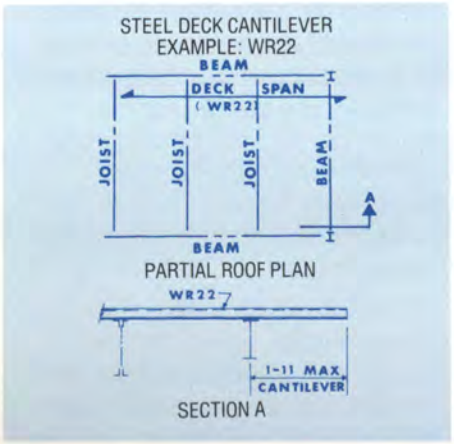

BUILDING DECK EDGE OR INTERIOR TERMINATION CONDITION

Recommended Maximum Spans for Construction and Maintenance Loads Standard for 1½ Inch and 3 Inch Roof Deck

	Type	Span Condition	Span Ft.-In.	Span Meters	Max. Recommended Spans Roof Deck Cantilever Ft.-In.	Max. Recommended Spans Roof Deck Cantilever Meters
Narrow Rib Deck	NR22	1	3′-10″	1.15 m	1′-0″	.30 m
	NR22	2 or more	4′-9″	1.45 m		
	NR20	1	4′-10″	1.45 m	1′-2″	.35 m
	NR20	2 or more	5′-11″	1.80 m		
	NR18	1	5′-11″	1.80 m	1′-7″	.45 m
	NR18	2 or more	6′-11″	2.10 m		
Intermediate Rib Deck	IR22	1	4′-6″	1.35 m	1′-2″	.35 m
	IR22	2 or more	5′-6″	1.65 m		
	IR20	1	5′-3″	1.60 m	1′-5″	.40 m
	IR20	2 or more	6′-3″	1.90 m		
Wide Rib Deck	WR22	1	5′-6″	1.65 m	1′-11″	.55 m
	WR22	2 or more	6′-6″	1.75 m		
	WR20	1	6′-3″	1.90 m	2′-4″	.70 m
	WR20	2 or more	7′-5″	2.25 m		
	WR18	1	7′-6″	2.30 m	2′-10″	.85 m
	WR18	2 or more	8′-10″	2.70 m		
Deep Rib Deck	3DR22	1	11′-0″	3.35 m	3′-5″	1.05 m
	3DR22	2 or more	13′-0″	3.95 m		
	3DR20	1	12′-6″	3.80 m	3′-11″	1.20 m
	3DR20	2 or more	14′-8″	4.45 m		
	3DR18	1	15′-0″	4.55 m	4′-9	1.45 m
	3DR18	2 or more	17′-8″	5.40 m		

Construction and maintenance loads:
SPANS are governed by a maximum stress of 26 ksi (180 MPa) and a maximum deflection of L/240 with a 200-pound (0.89 kN) concentrated load at midspan on a 1′-0″ (300 mm) wide section of deck. If the designer contemplates loads of greater magnitude, spans shall be decreased or the thickness of the steel deck increased as required.

All loads shall be distributed by appropriate means to prevent damage to the completed assembly during construction.



Cantilever loads:
Construction phase load of 10 psf (0.48 kPa) on adjacent span and cantilever, plus 200 pound load (0.89 kN) at end of cantilever with a stress limit of 26 ksi (180 MPa).

Service load of 45 psf (2.15 kPa) on adjacent span and cantilever, plus 100 pound load (0.44 kN) at end of cantilever with a stress limit of 20 ksi (140 MPa).

Deflection limited to L/240 of adjacent span for interior span and deflection at end of cantilever to L/240 of overhang.

Notes:

1. Adjacent span: Limited to those spans shown in Section 3.4 of Roof Deck Specifications. In those instances where the adjacent span is less than 3 times the cantilever span, the individual manufacturer should be consulted for the appropriate cantilever span.

2. Sidelaps must be attached at end of cantilever and at a maximum of 12 inches (300 mm) on center from end.

3. No permanent suspended loads are to be supported by the steel deck.

4. The deck must be completely attached to the supports and at the sidelaps before any load is applied to the cantilever.

4. Installation & Site Storage

4.1 Site Storage: Steel deck shall be stored off the ground with one end elevated to provide drainage, and shall be protected from the elements with a waterproof covering, ventilated to avoid condensation.

Continued on next page

SDI Specifications and Commentary

FOR STEEL ROOF DECK
Continued

4.2 Deck Placement: Place each deck unit on supporting structural frame. Adjust to final position with accurately aligned side laps and ends bearing on supporting members. On joist framing, be sure the appropriate end lap occurs over a top chord angle for proper anchorage.

Commentary: Staggering roof deck end laps is not a recommended practice. The deck capacity is not increased by staggering the end laps, yet layout and erection costs are increased.

4.3 Lapped or Butted Ends: Deck Ends may be either butted or lapped over supports. Standard tolerance for ordered length is plus or minus ½ inch (13 mm).

4.4 Anchorage: Roof deck units shall be anchored to supporting members including perimeter support steel and/or bearing walls by either welding or mechanical fasteners, to provide lateral stability to the top flange of the supporting structural members and to resist the following minimum gross uplifts; 45 pounds per square foot (2.15 kPa) for eave overhang; 30 pounds per square foot (1.44 kPa) for all other roof areas. The dead load of the roof deck construction shall be deducted from the above forces. The location and number of fasteners required for satisfactory attachment of deck to supporting structural members are as follows: All side laps plus a sufficient number of interior ribs to limit the spacing between adjacent points of attachment to 18 inches (500 mm). Deck units with spans greater than 5 feet (1.5 m) shall have side laps and perimeter edges (at perimeter support steel) fastened at midspan or 36 inches (1 m) intervals, whichever distance is smaller.

Commentary: The deck should be anchored to act as a working platform and to prevent blow off. The designer should check the appropriate codes for the required uplift loading and show the required anchorage connections on the plans. If no information is shown on the plans, the uplift loads shown in paragraph 4.4 will be assumed. Sidelap fasteners can be welds, screws, crimps (button punching), or other methods approved by the designer. Welding sidelaps on thicknesses 0.028 inches (.7 mm) or less may cause large burn holes and is not recommended. The objective of side lap fastening is to prevent differential sheet deflection. The five foot (1.5 m) limit on side lap spacing is based on experience.

The deck erector should not leave unattached deck at the end of the day as the wind may displace the sheets and cause injury to persons or property. In the past, 1½ inches (38 mm) of end bearing was the minimum; this is still a good "rule of thumb" that will, in general prevent slip off. If less than 1½ inches (38 mm) of end bearing is available, or if high support reactions are expected, the design engineer should ask the deck manufacturer to check the deck web stress. In any case, the deck must be adequately attached to the structure to prevent slip off.

The SDI *Diaphragm Design Manual, Second Edition,* should be used to determine fastening requirements if the deck is to be designed to resist horizontal loads. The most stringent requirements, of either section 4.4 or, if applicable, the SDI *Diaphragm Design Manual,* should be used.

4.4a Welding: All field welding of deck shall be in strict accordance with ANSI/AWS D1.3 *Structural Welding Code—Sheet Steel.* Each welder must demonstrate an ability to produce satisfactory welds using a procedure such as shown in the Steel Deck Institute *Manual of Construction with Steel Deck* or as described in ANSI/AWS D1.3. A minimum visible ⅝ inch (15 mm) diameter puddle weld or an elongated weld with an equal perimeter is required. Fillet welds, when used, shall be at least 1 inch (25 mm) long. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members. Welding washers shall be used on all deck units with a metal thickness less than 0.028 inches (0.7 mm). Welding washers shall be a minimum thickness of 0.056 inches (1.5 mm), 16 gage, and have a nominal ⅜ inch (10 mm) diameter hole. Care shall be exercised in the selection of electrodes and amperage to provide a positive weld and prevent high amperage blow holes.

Commentary: The obligation is placed on the contractor to prepare welding procedure specifications and to qualify them before production use. These procedure specifications must include classification of the filler metal, its size, and for each type of weld, its melting rate or any other suitable means of current control indicative of melting rate, as applicable.

The welder qualification test requires each welder to prove their ability to produce satisfactory welds using these qualified procedures. The fact that the welder may have been successfully qualified on plate or pipe under the provisions of ANSI/AWS D1.1 *Structural*

Welding Code—Steel, for structural welding, or on plate or pipe under the provisions of other codes governing the welding of specific products, does not qualify the welder for welding sheet steel.

The selections of welding rod and amperage are left to the individual welder. Welds are made from the top side of the deck, with the welder immediately following the placement crew. In general, stronger welds are obtained on 0.028 inches (.70 mm) or thicker deck without weld washers. Welds on deck less than 0.028 inches (.70 mm) are stronger with washers.

4.4b Mechanical Fasteners: Mechanical fasteners (powder-actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fasteners satisfy the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of any unfastened ribs.

Commentary: The allowable load value per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than $\frac{1}{8}$ inch (3 mm) and on the fastener providing a $\frac{5}{16}$ inch (8 mm) diameter minimum bearing surface (fastener head size).

5. Protective Coatings

5.1 Finishes: All steel to be used for roof deck shall be galvanized, aluminized or prime painted.

The roof deck shall be free of grease and dirt prior to the coating. The primer coat is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating.

Commentary: Field painting of prime painted deck is recommended especially where the deck is exposed. In corrosive or high moisture atmospheres, a galvanized finish is desirable in a G-60 (Z180) or G-90 (Z275) coating. In highly corrosive or chemical atmospheres or where reactive materials could be in contact with the steel deck, special care in specifying the finish should be used. In this case, individual manufacturers should be contacted. See important information Section 4.1 Insulation, page 7.

5.2 Fireproofing: The metal deck manufacturer shall not be responsible for the cleaning of the underside of metal deck to ensure bond of fireproofing. Adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

6. Erection

Deck sheets will be placed in accordance with approved erection layout drawing supplied by the deck manufacturer and in conformance with the deck manufacturer's standards. End joints of sheets shall occur over supports.

Commentary: Openings greater than 25 square feet (2.3 m^2) are generally located and shown on the detailed erection drawings, and deck will be provided to the job in lengths to accommodate the opening. Openings less than 25 square feet (2.3 m^2) can be located and shown on the erection drawings and be decked over; the deck erector is to cut these openings as well as provide any skew cutting shown.

It is extremely important that deck cantilevers and decked over areas are not overloaded. Openings in the deck and building edges must be protected by using OSHA approved methods.

Openings not shown on the erection drawings, such as those required for stacks, conduits, plumbing, vents, etc. are to be cut, and reinforced if necessary, by the trades requiring the openings. Refer to the SDI *Manual of Construction With Steel Deck* for a reinforcing schedule.

7. Insulation

Insulation board shall be of sufficient strength and thickness to permit unsupported spans and edges over the deck's rib openings. Cementitious insulating fills shall be poured only over galvanized deck and shall be adequately vented. In all cases, the recommendations of the insulation manufacturer shall be followed.

8. CAUTION

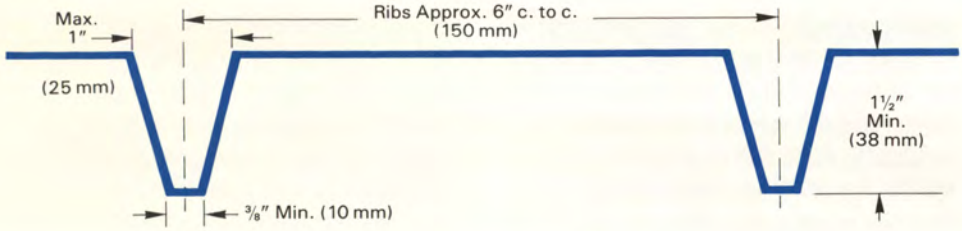
Steel roof deck may be used in a variety of ways, some of which do not lend themselves to a standard "steel deck" analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

Continued on next page

SDI Standard Roof Deck

LOAD TABLES

Narrow Rib Deck
Type NR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds per Square Foot Span Length—c. to c. Joists or Purlins (Ft.-In.)												
			4′-0″	4′-6″	5′-0″	5′-6″	6′-0″	6′-6″	7′-0″	7′-6″					
NR 22	Simple	0.0295	73	58	47										
NR 20		0.0358	91	72	58	48	40								
NR 18		0.0474	125	99	80	66	55	47							
NR 22	2	0.0295	80	63	51	42									
NR 20		0.0358	97	76	62	51	43								
NR 18		0.0474	128	101	82	68	57	48	42						
NR 22	3 or more	0.0295	100	79	64	53	44								
NR 20		0.0358	121	96	77	64	54	46							
NR 18		0.0474	160	126	102	85	71	61	52	45					

Deck Type	Span Condition	Design Thickness (mm)	Uniform Total (Dead & Live) Load in kPa Span Length—c. to c. Joists or Purlins (m)												
			1.25	1.50	1.75	2.00	2.25	2.50							
NR 22	Simple	0.75	3.5	2.4	1.8										
NR 20		0.90	4.3	3.0	2.2										
NR 18		1.20	6.0	4.1	3.0	2.3	1.8								
NR 22	2	0.75	3.8	2.7	2.0										
NR 20		0.90	4.6	3.2	2.4	1.8									
NR 18		1.20	6.1	4.3	3.1	2.4	1.9								
NR 22	3 or more	0.75	4.8	3.3	2.5	1.9									
NR 20		0.90	5.7	4.0	2.9	2.3	1.8								
NR 18		1.20	7.6	5.3	3.9	3.0	2.4	1.9							

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½ inch (38, 50, 75, 115, 150, 190 mm) depths: 6, 8, and 12 inch (150, 200, 305 mm) rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf (kPa). All loads are governed by the allowable flexural stress limit of 20 ksi (140 MPa) for a 33 ksi (230 MPa) minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center to center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

   Simple and Two Span $M = \frac{w\ell^2}{8}$ Three Span or More $M = \frac{w\ell^2}{10}$

6. Deflection formulae for deflection limitation are:

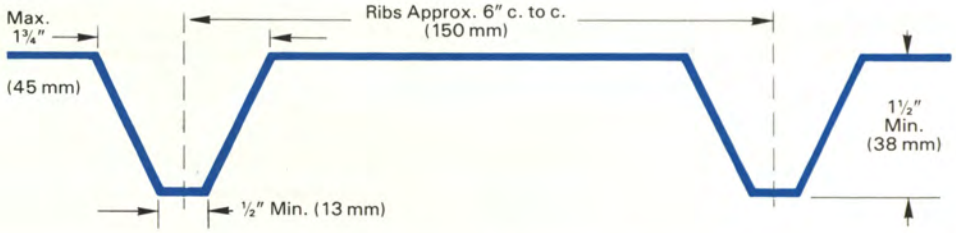
   Simple Span $\Delta = \frac{.013\, w\ell^4}{EI}$ Two Span $\Delta = \frac{.0054\, w\ell^4}{EI}$ Three Span $\Delta = \frac{.0069\, w\ell^4}{EI}$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet (1.5 m) or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

w = PSF UNITS (kPa) **ℓ** = Ft. (m) **E** = 29.5×10^6 PSI (210,000 MPa) **I** = In.⁴/Ft. (mm⁴/m)

LOAD TABLES
Continued

Intermediate Rib Deck Type IR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds per Square Foot Span Length—c. to c. Joists or Purlins (Ft.-In.)												
			4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"			
IR 22	Simple	0.0295	84	66	54	44									
IR 20		0.0358	104	82	67	55	46								
IR 18		0.0474	142	112	91	75	63	54	46	40					
IR 22	2	0.0295	90	71	58	48	40								
IR 20		0.0358	110	87	70	58	49	41							
IR 18		0.0474	145	114	93	77	64	55	47	41					
IR 22	3 or more	0.0295	113	89	72	60	50	43							
IR 20		0.0358	137	108	88	72	61	52	45						
IR 18		0.0474	181	143	116	96	81	69	59	52	45	40			

Deck Type	Span Condition	Design Thickness (mm)	Uniform Total (Dead & Live) Load in kPa Span Length—c. to c. Joists or Purlins (m)												
			1.25	1.50	1.75	2.00	2.25	2.50	2.75						
IR 22	Simple	0.75	4.0	2.8	2.1										
IR 20		0.90	4.9	3.4	2.5	1.9									
IR 18		1.20	6.8	4.7	3.5	2.7	2.1								
IR 22	2	0.75	4.3	3.0	2.2										
IR 20		0.90	5.2	3.6	2.7	2.0									
IR 18		1.20	6.9	4.8	3.5	2.7	2.1								
IR 22	3 or more	0.75	5.4	3.8	2.8	2.1									
IR 20		0.90	6.5	4.5	3.3	2.6	2.0								
IR 18		1.20	8.6	6.0	4.4	3.4	2.7	2.2	1.8						

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½ inch (38, 50, 75, 115, 150, 190 mm) depths: 6, 8, and 12 inch (150, 200, 305 mm) rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf (kPa). All loads are governed by the allowable flexural stress limit of 20 ksi (140 MPa) for a 33 ksi (230 MPa) minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center to center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

   Simple and Two Span $M = \frac{w\ell^2}{8}$ Three Span or More $M = \frac{w\ell^2}{10}$
6. Deflection formulae for deflection limitation are:

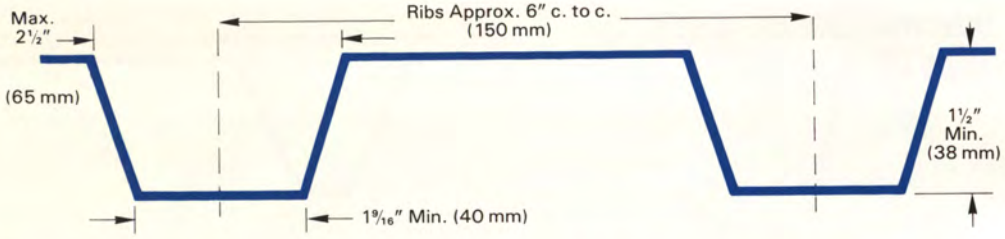
   Simple Span $\Delta = \frac{.013\, w\ell^4}{EI}$ Two Span $\Delta = \frac{.0054\, w\ell^4}{EI}$ Three Span $\Delta = \frac{.0069\, w\ell^4}{EI}$
7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet (1.5 m) or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

w = PSF UNITS (kPa) **ℓ** = Ft. (m) **E** = 29.5×10^6 PSI (210,000 MPa) **I** = In.⁴/Ft. (mm⁴/m)

SDI Standard Roof Deck

LOAD TABLES
Continued

Wide Rib Deck
Type WR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds per Square Foot Span Length—c. to c. Joists or Purlins (Ft.-In.)												
			4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
WR 22	Simple	0.0295			90	70	56	46							
WR 20		0.0358			113	88	70	57	48	40					
WR 18		0.0474			159	122	96	77	64	54	46	40			
WR 22	2	0.0295			96	79	67	57	49	43					
WR 20		0.0358			123	102	86	73	63	55	48	43			
WR 18		0.0474			164	136	114	98	84	73	64	57	51	46	41
WR 22	3 or more	0.0295			119	99	83	71	61	53	47	41	36		
WR 20		0.0358			153	127	107	91	79	68	58	50	43		
WR 18		0.0474			204	169	142	121	105	91	79	67	58	51	

Deck Type	Span Condition	Design Thickness (mm)	Uniform Total (Dead & Live) Load in kPa Span Length—c. to c. Joists or Purlins (m)											
			1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25				
WR 22	Simple	0.75	4.7	3.1	2.2									
WR 20		0.90	5.8	3.8	2.7	2.1								
WR 18		1.20	8.2	5.4	3.8	2.8	2.2							
WR 22	2	0.75	4.9	3.6	2.8	2.2	1.8							
WR 20		0.90	6.2	4.6	3.5	2.8	2.3	1.9						
WR 18		1.20	8.4	6.2	4.8	3.8	3.1	2.5	2.1	1.8				
WR 22	3 or more	0.75	6.1	4.5	3.5	2.8	2.2	1.8						
WR 20		0.90	7.7	5.7	4.4	3.5	2.7	2.1						
WR 18		1.20	10.4	7.7	5.9	4.7	3.7	2.9	2.3	1.9				

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½ inch (38, 50, 75, 115, 150, 190 mm) depths: 6, 8, and 12 inch (150, 200, 305 mm) rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf (kPa). Loads in shaded areas are governed by live load deflection not in excess of $\ell/240$, the dead load included is 10 PSF (0.478 kPa). All loads are governed by the allowable flexural stress limit of 20 ksi (140 MPa) for a 33 ksi (230 MPa) minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center to center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

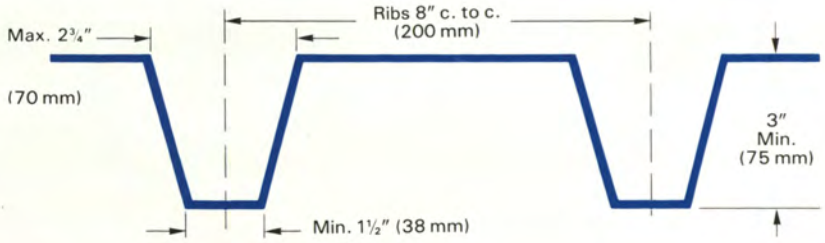
   Simple and Two Span $M = \frac{w\ell^2}{8}$ Three Span or More $M = \frac{w\ell^2}{10}$
6. Deflection formulae for deflection limitation are:

   Simple Span $\Delta = \frac{.013\, w\ell^4}{EI}$ Two Span $\Delta = \frac{.0054\, w\ell^4}{EI}$ Three Span $\Delta = \frac{.0069\, w\ell^4}{EI}$
7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet (1.5 m) or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

[w] = PSF UNITS (kPa) [ℓ] = Ft. (m) [E] = 29.5×10^6 PSI (210,000 MPa) [I] = In.⁴/Ft. (mm⁴/m)

LOAD TABLES
Continued

Deep Rib Deck
Type 3DR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds per Square Foot Span Length—c. to c. Joists or Purlins (Ft.-In.)											
			9'-0"	9'-6"	10'-0"	10'-6"	11'-0"	11'-6"	12'-0"	12'-6"	13'-0"	13'-6"	14'-0"	14'-6"
3DR 22	Simple	0.0295	52	47	42									
3DR 20		0.0358	65	58	53	48	43	40						
3DR 18		0.0474	89	80	72	66	60	55	49	45	41			
3DR 22	2	0.0295	59	53	48	44	40							
3DR 20		0.0358	72	65	59	53	48	44	41					
3DR 18		0.0474	96	86	78	70	64	59	54	50	46	43	40	
3DR 22	3 or more	0.0295	74	66	60	54	50	45	42					
3DR 20		0.0358	90	81	73	66	60	55	51	47	43	40		
3DR 18		0.0474	120	107	97	88	80	73	67	62	57	53	50	46

Deck Type	Span Condition	Design Thickness (mm)	Uniform Total (Dead & Live) Load in kPa Span Length—c. to c. Joists or Purlins (m)											
			2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00		
3DR 22	Simple	0.75	2.6	2.2	1.9									
3DR 20		0.90	3.2	2.7	2.3	2.0								
3DR 18		1.20	4.4	3.7	3.2	2.7	2.3	1.9						
3DR 22	2	0.75	2.9	2.5	2.1	1.8								
3DR 20		0.90	3.6	3.0	2.5	2.2	1.9							
3DR 18		1.20	4.7	4.0	3.4	2.9	2.6	2.2	2.0					
3DR 22	3 or more	0.75	3.6	3.1	2.6	2.3	2.0							
3DR 20		0.90	4.4	3.7	3.2	2.7	2.4	2.1	1.9					
3DR 18		1.20	5.9	5.0	4.2	3.7	3.2	2.8	2.5	2.2	2.0	1.8		

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½ inch (38, 50, 75, 115, 150, 190 mm) depths: 6, 8, and 12 inch (150, 200, 305 mm) rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf (kPa). Loads in shaded areas are governed by live load deflection not in excess of $\ell/240$, the dead load included is 10 PSF (0.478 kPa). All loads are governed by the allowable flexural stress limit of 20 ksi (140 MPa) for a 33 ksi (230 MPa) minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center to center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

   Simple and Two Span $M = \frac{w\ell^2}{8}$ Three Span or More $M = \frac{w\ell^2}{10}$

6. Deflection formulae for deflection limitation are:

   Simple Span $\Delta = \frac{.013\, w\ell^4}{EI}$ Two Span $\Delta = \frac{.0054\, w\ell^4}{EI}$ Three Span $\Delta = \frac{.0069\, w\ell^4}{EI}$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet (1.5 m) or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

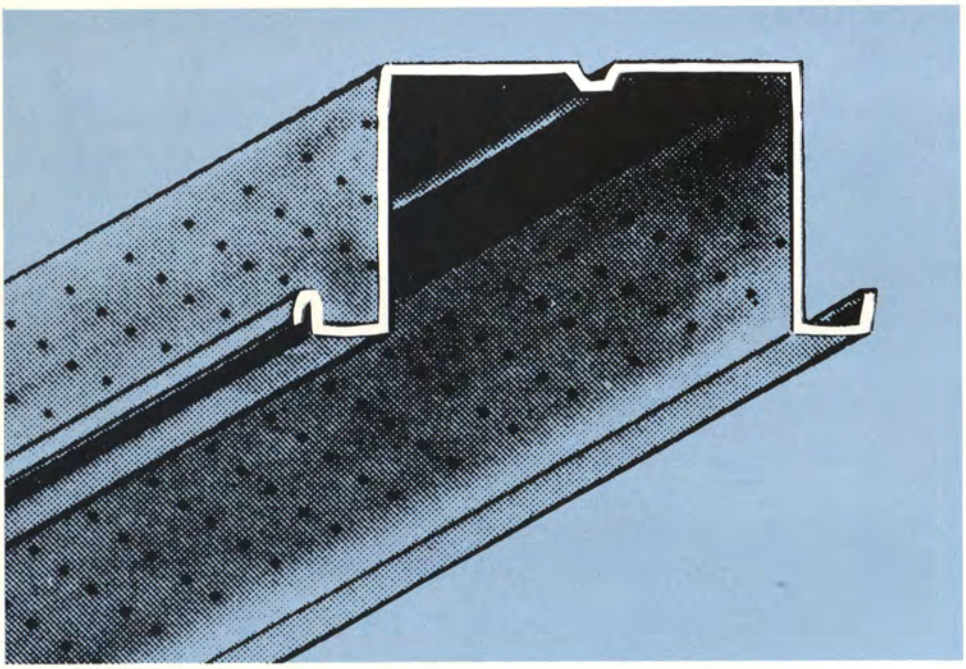
w = PSF UNITS (kPa) **ℓ** = Ft. (m) **E** = 29.5×10^6 PSI (210,000 MPa) **I** = In.⁴/Ft. (mm⁴/m)

Acoustical Decks

Acoustical Decks—Sound absorbing decks are available in the following profiles; 1½ inch (38 mm) wide rib type WR, 2 inch (50 mm), 3 inch (75 mm) deep rib type 3DR, and Long Span Decks, 4½ inch (115 mm), 6 inch (150 mm), and 7½ inch (190 mm). All of these sections can be furnished as plated cellular roof or floor decks.

These Sound Absorbing Decks Can Serve as Combination Acoustical Ceiling and Structural Deck.

The steel deck is perforated so that it serves as a finished ceiling as well as platform for the sound absorbing element. In open rib decks, the sound absorbing elements are field installed by the roofing contractor. For cellular decks, contact the manufacturer. The load carrying capacity of the deck may be affected due to the perforations. Individual member companies' catalogs should be consulted for specific design information.



The NRC value for wide rib type WR is 0.65 and deep rib type 3DR is 0.70 when tested with 1.65 PCF sound absorbing fiberglass batts and 3 inch EPS Plaza Deck foam insulation board above the deck. Copies of these reports are available from SDI.

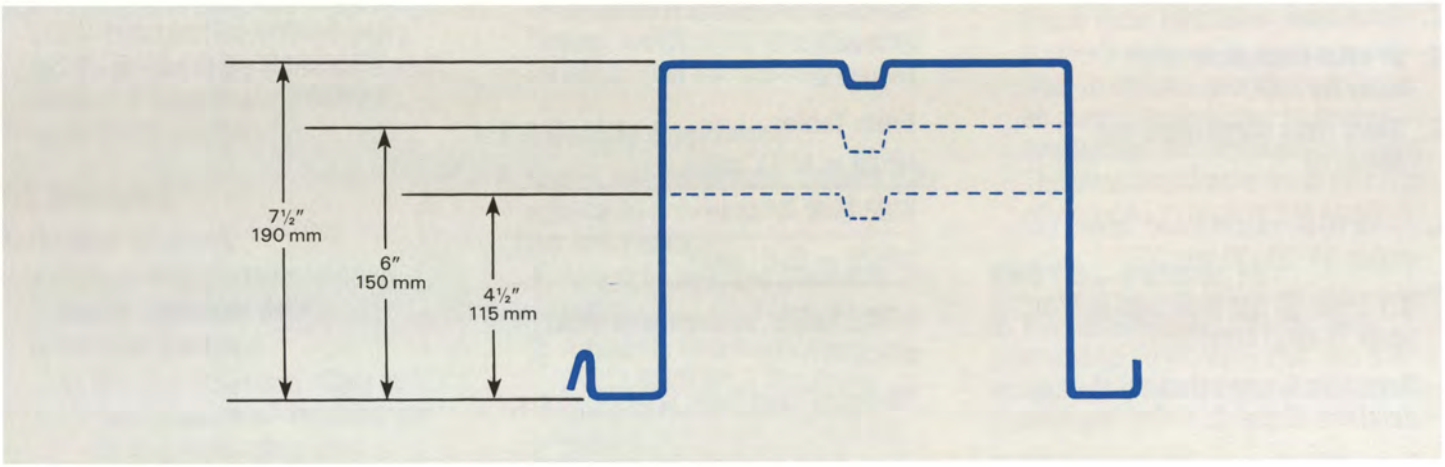
Individual deck manufacturers should be consulted for the NRC values that can be obtained by the use of a specific product.

The finish for acoustical decks should be either galvanized or galvanized and painted.

ROOF DECKS

Long Span Roof Decks are used to support roofing materials and design live loads for spans up to and exceeding thirty feet (9 m). The bottom side presents an attractive finish which can be field painted to enhance the appearance.

When Long Span Roof Decks are used to span between masonry walls, the ceiling is not cluttered with beams or joists. In addition, building height is reduced. For very large open areas, a minimum of support members are required.



CELLULAR ROOF DECKS

Cellular Roof Decks are available in the following profiles: 1½ inch (38 mm) wide rib type WR, 3 inch (75 mm) deep rib type DR, and Long Span Decks, 4½ inch (115 mm), 6 inch (150 mm), and 7½ inch (190 mm). These decks can be provided as standard or acoustical.

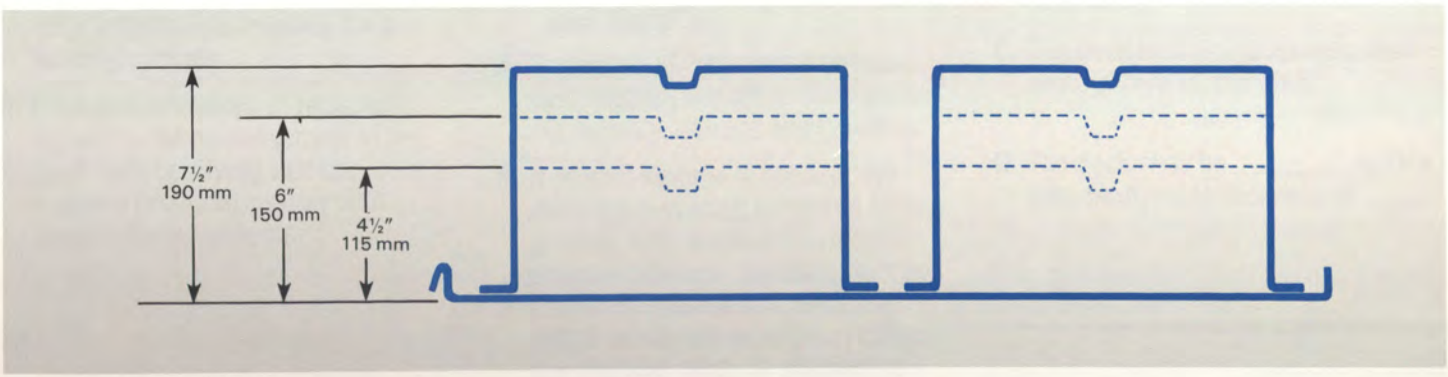
The addition of the bottom plate increases the span and load carrying capabilities of the roof decks. The bottom side presents a flush ceiling.

In acoustical deck the bottom side is perforated and sound absorbing elements are provided. Contact the manufacturer concerning installation (factory or field installed).

Cellular Roof Decks are manufactured by resistance welding of the upper and lower elements. If the appearance is of concern in the final installed condition, consideration can be given by the designer to specify finished postweld surface treatment.

Special field applied paints or embossed and textured metal surfaces may be specified. Contact the manufacturer for specific recommendations when specifying such surface treatment.

For economy, appearance, increased load capacity and ease of construction, Cellular Roof Decks are an excellent choice.



DESIGN EXAMPLE

Given:

A. Joist spacing 6′-0″ c. to c.

B. Live load = 30 psf

C. Total load = 50 psf

D. 2″ total insulation with built-up roof.*

E. Steel deck diaphragm not required.**

1. Refer to Standard Load Tables on pages 34, 35, 36 and 37.

1.1 Enter 50 psf total load at 6′-0″ span, 3-span condition.

Select deck types that equal or exceed the 50 psf (2.4 kPa) required.

From Table:

NR20 = 53 psf capacity

IR22 = 52 psf capacity

WR22 = 85 psf capacity

2. Refer to *Maximum Spans for Construction and Maintenance Loads* on page 31.

Select deck types that equal or exceed the 6′-0″ (1.75 m) span required.

From Table:

NR20 = 6′-11″ span

IR20 = 6′-3″ span

WR22 = 6′-6″ span

WR22 fulfills requirements most efficiently.

*Refer to Roof Deck Specifications, Section 7—Insulation, page 33. Also refer to insulation manufacturers' recommendations for maximum allowable rib opening.

**If the steel deck is required to act as a diaphragm, refer to *Steel Deck Institute Diaphragm Design Manual First Edition (DDM01)* and *Second Edition (DDM02)*, publications of the Steel Deck Institute.

SDI Short Form Specifications

FOR COMPOSITE FLOOR DECK

PART 1—GENERAL

1.1 Related Documents

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 Summary

B. Related Sections

a. This section pertains to composite steel floor deck.

b. Related Sections

1. Division 3 Section "Cast In Place Concrete" for concrete fill and reinforcing steel.
2. Division 5 Section "Structural Steel" for structural steel supporting the deck.

1.3 Submittals

A. General: Submit each item in this Article according to the conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of decking specified, including dimensions of individual components, profiles, and finishes.

C. Shop Drawings showing location of deck units, anchorage details, and other information required for a thorough review

D. Product Certificates (if required) signed by the manufacturer of the steel deck certifying that the supplied products comply with specified requirements.

E. Welder Certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article, or if mechanical fasteners are used, test reports from a qualified independent testing agency evidencing compliance of mechanical fasteners with requirements based on comprehensive testing.

1.4 Quality Assurance

A. Codes and Standards: Comply with applicable provisions of the following specifications:

1. American Iron and Steel Institute (AISI);
2. American Welding Society (ANSI/AWS D1.3 Structural Welding Code/Sheet Steel);
3. Steel Deck Institute (SDI).

B. Certify that each welder has satisfactorily passed A.W.S. qualification tests for welding processes involved, and, if applicable, has undergone recertification.

C. Fire Resistance Assemblies: Provide steel deck units listed by Underwriters Laboratories (UL) in the "Fire Resistance Directory" for design number_____. (If a fire rated assembly is required.)

1. Identify steel deck bundles with labels bearing the U.L. mark.

1.5 Delivery, Storage, and Handling

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage and handling.

B. If ground storage is needed, the deck bundles must be stored off the ground, with one end elevated to provide drainage. Bundles must be protected against condensation with a ventilated waterproof covering. Bundles must be stacked so there is no danger of tipping, sliding, rolling, shifting or material damage. Bundles must be periodically checked for tightness, and retightened as necessary so wind cannot loosen sheets.

C. Deck bundles placed on the building frame must be placed near a main supporting beam at a column or wall. In no case are the bundles to be placed on unbolted frames or on unattached and/or unbridged joists. The structural frame must be properly braced to receive the bundles.

PART 2—PRODUCTS

2.1 A manufacturer offering deck products to be incorporated into the work must be a member of the Steel Deck Institute.

2.2 Materials **[The specifier must choose the appropriate section(s) and eliminate those not applicable.]**

A. Sheet steel for deck and accessories shall conform to ASTM A653-94 Structural Quality with a minimum yield strength of 33 ksi (230 MPa).

1. Galvanizing shall conform to ASTM A924-94 with a minimum coating class of G60 (Z180) as defined in ASTM A653-94.

or

B. Sheet steel for deck and accessories shall conform to ASTM A611 with a minimum yield strength of 33 ksi (230 MPa).

C. The deck type and thickness shall be as shown on the plans.

or

D. The deck shall be _____ with a minimum metal thickness of ____.

or

Continued on next page

SDI Short Form Specifications

FOR COMPOSITE FLOOR DECK *Continued*

E. The deck shall be selected to provide the load capacities shown on the drawings and as determined using the Steel Deck Institute construction loading criteria.

F. Whenever possible, the deck shall be multi-span and not require shoring during the concrete placement procedure.

G. The deck type provided shall be capable of supporting the superimposed live loads as shown on the plans.

2.3 Accessories

A. Pour stops, column closures, end closures, cover plates, and girder fillers shall be the type required by the Steel Deck Institute.

B. Mechanical fasteners or welds are acceptable for accessory attachments.

PART 3—EXECUTION

3.1 Examine support framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work of this section. All O.S.H.A. rules for erection must be followed.

3.2 Preparation

A. Place deck in accordance with approved placement plans.

B. Do not place deck panels on concrete support structure until concrete has cured and is dry.

C. Locate deck bundles to prevent overloading of support members.

3.3 Installation, General

A. Install deck panels and accessories according to Steel Deck Institute specifications and recommendations, and in accordance with the placement plans, and requirements of this Section.

B. Install temporary shoring, if required, before placing deck panels.

C. Place deck panels on structural supports and adjust to final position with ends aligned. Attach firmly to the supports immediately after placement in order to form a safe working platform.

D. Cut and neatly fit deck units and accessories around openings and other work projecting through or adjacent to the decking.

E. Trades that subsequently cut unscheduled openings through the deck are responsible for reinforcing the openings.

3.4 Installation, Floor Deck

A. Anchor floor deck units to steel supporting members by arc spot puddle welds of the following diameter and spacing or fillet welds of equal strength.

1. **Weld diameter:** minimum visible 5/8 inch (15 mm).
2. **Weld spacing:** Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (300 mm) apart but not more than 18 inches (460 mm).
3. Mechanical fasteners, either powder actuated or pneumatically driven, or screws may be used in lieu of welding to fasten deck to supporting framing, provided they have been specifically approved.
4. Fasten side laps and perimeter edges of units between supports at intervals not exceeding 36 inches (1 m) on center, using one of the following methods:
   - **a.** #10 self drilling screws;
   - **b.** crimp or button punch;
   - **c.** arc puddle welds 5/8 inch (15 mm) minimum visible diameter, or 1 inch (25 mm) long fillet welds.

B. End Bearing: Install deck ends over supports with a minimum end bearing of 1.5 inches (40 mm).

C. Pour Stops and Girder Fillers: Fasten pour stops and girder fillers to supporting structure according to the manufacturers recommendations.

D. Floor Deck Closures: Fasten column closures, cell closures, and Z closures to deck to provide tight fitting closures at open ends of ribs and sides of decking. Fasten cell closures at changes of direction of floor deck units unless otherwise directed.

3.5 Repairs

A. Before concrete placement, the deck shall be inspected for tears, dents, or other damage that may prevent the deck from acting as a tight and substantial form. The need for the repair or temporary shoring of the damaged deck shall be determined.

SDI Short Form Specifications

FOR NON-COMPOSITE FORM DECK

PART 1—GENERAL

1.1 Related Documents

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 Summary

B. Related Sections

a. This section pertains to non-composite steel form deck.

b. Related Sections

1. Division 3 Section "Cast In Place Concrete" for concrete fill and reinforcing steel.
2. Division 5 Section "Structural Steel" for structural steel supporting the deck.
3. Division 7 section "Insulating Fill".

1.3 Submittals

A. General: Submit each item in this Article according to the conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of decking specified, including dimensions of individual components, profiles, and finishes.

C. Shop Drawings showing location of deck units, anchorage details, and other information required for a thorough review.

D. Product Certificates (if required) signed by the manufacturer of the steel deck, certifying the supplied products comply with specified requirements.

E. Welder Certificates signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" Article, or if mechanical fasteners are used, test reports from a qualified independent testing agency evidencing compliance of mechanical fasteners with requirements based on comprehensive testing.

1.4 Quality Assurance

A. Codes and Standards: Comply with applicable provisions of the following specifications:

1. American Iron and Steel Institute (AISI);
2. American Welding Society (ANSI/AWS D1.3 Structural Welding Code/Sheet Steel);
3. Steel Deck Institute (SDI).

B. Certify that each welder has satisfactorily passed A.W.S. qualification tests for welding processes involved, and, if applicable, has undergone recertification.

1.5 Delivery, Storage, and Handling

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage and handling.

B. If ground storage is needed, the deck bundles must be stored off the ground, with one end elevated to provide drainage. Bundles must be protected against condensation with a ventilated waterproof covering. Bundles must be stacked so there is no danger of tipping, sliding, rolling, shifting or material damage. Bundles must be periodically checked for tightness and retightened as necessary so wind cannot loosen sheets.

C. Deck bundles placed on the building frame must be placed near a main supporting beam at a column or wall. In no case, are the bundles to be placed on unbolted frames or on unattached and/or unbridged joist. The structural frame must be properly braced to receive the bundles.

PART 2—PRODUCTS

2.1 A manufacturer offering deck products to be incorporated into the work must be a member of the Steel Deck Institute.

2.2 Materials **[The specifier must choose the appropriate section(s) and eliminate those not applicable.]**

A. Sheet steel for deck and accessories shall conform to ASTM A653-94 Structural Quality, minimum yield strength of 33 ksi(230 MPa).

1. Galvanizing shall conform to ASTM A924-94 with a minimum coating class of G60 (Z180) as defined in A653-94.

or

B. Sheet steel for deck and accessories shall conform to ASTM A611 with a minimum yield strength of 33 ksi (230 MPa).

C. The deck type and thickness shall be as shown on the plans.

or

D. The deck shall be _____ with a minimum metal thickness of ____.

or

Continued on next page

FOR NON-COMPOSITE FORM DECK *Continued*

E. The deck shall be selected to provide the load capacities shown on the drawings and as determined using the Steel Deck Institute construction loading criteria.

F. Whenever possible, the deck shall be multi-span and not require shoring during the concrete placement procedure.

2.3 Accessories

A. Pour stops, column closures, end closures, cover plates, and girder fillers shall be the type required by the Steel Deck Institute.

B. Mechanical fasteners or welds are acceptable for accessory attachments.

PART 3—EXECUTION

3.1 Examine support framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work of this section. All O.S.H.A. rules for erection must be followed.

3.2 Preparation

A. Place deck in accordance with approved placement plans.

B. Do not place deck panels on concrete support structure until concrete has cured and is dry.

C. Locate deck bundles to prevent overloading of support members.

3.3 Installation, General

A. Install deck panels and accessories according to Steel Deck Institute specifications and recommendations, and in accordance with the placement plans, and requirements of this Section.

B. Install temporary shoring, if required, before placing deck panels.

C. Place deck panels on structural supports and adjust to final position with ends aligned. Attach firmly to the supports immediately after placement in order to form a safe working platform.

D. Cut and neatly fit deck units and accessories around openings and other work projecting through or adjacent to the decking.

E. Trades that subsequently cut unscheduled openings through the deck are responsible for reinforcing the openings.

3.4 Installation, Form Deck

A. Anchor deck units to steel supporting members by arc spot puddle welds of the following diameter and spacing, or fillet welds of equal strength.

1. For deck units with metal thickness equal to or greater than 0.028 inches (22 gage, 0.7 mm) use 5/8 inch (15 mm) minimum visible diameter welds with the weld pattern shown on the design drawings.
2. For deck units with metal thickness less than 0.028 inches (22 gage, 0.7 mm) weld deck through manufacturer's standard welding washers with the weld pattern shown on the design drawings.
3. Mechanical fasteners, either powder actuated or pneumatically driven, or screws may be used in lieu of welding to fasten deck to supporting framing, provided they have been specifically approved.
4. Fasten side laps and perimeter edges of units between supports at intervals not exceeding 36 inches (1 m) on center, using one of the following methods:
   - **a.** #10 self drilling screws;
   - **b.** crimp or button punch;
   - **c.** arc puddle welds—5/8 inch (15 mm) minimum visible diameter or 1 inch (25 mm) long fillet welds.

B. Install deck ends over supports with a minimum end bearing of 1.5 inches (40 mm).

C. Fasten pour stops and girder fillers to supporting structure according to the manufacturers recommendations.

D. Fasten column closures, cell closures, and Z closures to deck to provide tight fitting closures at open ends of ribs and sides of decking. Fasten cell closures at changes of direction of deck units unless otherwise directed.

3.5 Repairs

A. Before concrete placement, the deck shall be inspected for tears, dents, or other damage that may prevent the deck from acting as a tight and substantial form. The need for the repair or temporary shoring of the damaged deck shall be determined.

SDI Short Form Specifications

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION

PART 1—GENERAL

1.1 Summary

The requirements of this Specification Section include all materials, equipment and labor necessary to furnish and install Cellular Deck that is used as a component of an in-floor distribution system for electrical-type services. The complete system shall be referred to as a Cellular Floor System. Included in the System shall be Cellular Deck, alternating Non-Cellular Deck and related components for in-floor distribution of electrical-type services.

A. Cellular Deck shall serve as composite or non-composite type floor deck and/or as a raceway for the in-floor distribution for electrical-type services.

B. A Cellular Floor System shall include all Cellular Deck units or an alternating combination of Cellular and Non-Cellular Deck units as indicated on the design drawings.

C. In order to provide a complete in-floor distribution system for electrical-type services, specialized components for this purpose shall be available. These components shall be referred to as compatible electrical components and shall be furnished under this Specification Section for installation by the electrical contractor. Compatible electrical components to be furnished may include: preset inserts, activation kits, afterset inserts, service fittings, header ducts and trench header ducts.

1.2 Related Sections

Work that is related to, but not part of, this Specification Section may be included in the following sections:

A. Cast-In-Place Concrete: concrete fill, welded wire fabric, reinforcing steel and temporary shoring.

B. Structural Steel: supporting members and shear studs.

C. Fireproofing: preparation of deck surfaces for application of fireproofing materials.

D. Electrical: wires, power cables, receptacles, voice and signal connectors, underfloor duct, and all electrical raceway components located above the finished floor slab.

1.3 Submittals

In accordance with applicable requirements of the contract documents, submit the following for approval:

A. Product data for all components of the Cellular Floor System including material types, dimensions, finishes, load capacities and fire resistance ratings.

B. Erection drawings and installation instructions for all components of the Cellular Floor System including profiles and material thicknesses, layout, anchorage, openings as dimensioned on the design drawings and shoring requirements.

1.4 Quality Assurance

A. Section Properties: Shall be computed in accordance with the latest edition (1986 and Addenda) of the AISI *Specification for the Design of Cold-Formed Steel Structural Members.*

B. Welding: Shall comply with applicable provisions of ANSI/AWS D1.3-89 *Structural Welding Code—Sheet Steel.*

C. Cast-In-Place Concrete: Shall be provided in accordance with applicable sections of chapters 3, 4 and 5 of ACI 318 Building Code Requirement for Reinforced Concrete. Minimum compressive strength shall be 3 ksi (20 MPa). Admixtures containing chloride salts shall not be used.

D. Fire Resistance Classification: Shall be provided in accordance with an Underwriters Laboratories Fire Resistance Design Number as indicated on the design drawings. All components of the Cellular Floor System used in rated fire resistance designs shall bear the appropriate UL classification marking.

E. Electrical Requirements: Shall comply with applicable provisions of Article 356 of the *National Electric Code* and UL Standard for Safety No. 209. The manufacturer shall be listed in Underwriters Laboratories Electrical Construction Materials Directory under the category *Cellular Metal Floor.*

F. General Requirements: Shall be in accordance with all applicable provisions of the Steel Deck Institute.

1.5 Delivery, Storage and Handling

All components of the Cellular Floor System shall be protected from significant damage during shipment and handling. If storage at the jobsite is required, bundles or packages of these materials shall be elevated above the ground, sloped to provide drainage and protected from the elements with a ventilated waterproof covering.

Continued on next page

SDI Short Form Specifications

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION *Continued*

PART 2—PRODUCTS

2.1 Materials

A. Cellular and alternating Non-Cellular Deck units shall be cold-formed from steel sheets conforming to ASTM A653-94 Structural Quality with a minimum yield strength of 33 ksi (230 MPa).

B. Before forming, the steel sheets shall have received a hot-dip protective coating of zinc conforming to ASTM A924-94 with a minimum coating class of G60 (Z180) as defined in ASTM A653-94.

C. The minimum uncoated thickness of materials furnished shall not be less than 95% of the design thickness.

2.2 Fabrication

A. Cellular Deck units shall be fabricated by welding a fluted top "hat" section to a bottom "plate" section. The combination of these sections shall form "cells" that may be utilized as raceways for electrical-type services.

B. Design thickness, minimum section properties and configuration of the Cellular and alternating Non-Cellular Deck units shall be indicated on the design drawings.

C. Cellular and alternating Non-Cellular Deck units shall be fabricated to provide a minimum three span condition whenever possible.

D. Factory made openings in the top "hat" sections of Cellular Deck units shall be provided at preset insert locations and at typical intersections with header ducts or trench header ducts as indicated on the design drawings.

2.3 Accessories

A. Column closures, end closures and side closures shall be provided per manufacturer's standards.

B. Slab edge forms of 10 gage or less material thickness shall be provided as indicated on the design drawings.

C. Appropriate ground continuity plates shall be provided for Cellular Deck units that are supported by underlying concrete slabs.

2.5 Compatible Electrical Components

A. Preset Inserts: Provide manufacturer's standard Preset Inserts at locations as indicated on the design drawings.

B. Activation Kits: Provide manufacturer's standard Activation Kits at Preset Insert locations as indicated on the design drawings and/or in designated numbers.

C. Afterset Inserts: Provide designated numbers of manufacturer's standard Afterset Inserts.

D. Service Fittings: Provide manufacturer's standard Service Fittings in designated numbers.

E. Header Ducts and Trench Header Ducts: Provide manufacturer's standard Header Ducts and/or Trench Header Ducts at locations as indicated on the design drawings. Width, depth and compartment configuration shall be indicated on the design drawings.

PART 3—EXECUTION

3.1 Examination

A. Before installation begins, supporting members and/or underlying concrete slabs shall be examined and accepted for installation of a Cellular Floor System.

3.2 Installation

The Cellular Floor System shall be installed in strict accordance with the manufacturer's approved erection drawings and all applicable safety regulations. Raceways shall not be penetrated by fasteners with sharp points or edges that could damage wires or cables.

A. Bundles or packages of Cellular Floor System components shall be placed on supporting members in such a manner that overloading of any of the individual framing members does not occur. Components shall not be placed on underlying concrete slabs until after the slabs have adequately cured.

B. Before being permanently fastened, Cellular and alternating Non-Cellular Deck units shall be placed with accurate alignment and proper end bearing on supporting members or underlying concrete slabs.

C. Immediately after alignment is completed, Cellular and alternating Non-Cellular Deck units shall be fastened to supporting members or underlying concrete slabs as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

FOR CELLULAR DECK FLOOR SYSTEMS WITH ELECTRICAL DISTRIBUTION *Continued*

D. After fastening to supporting members is completed, Cellular and alternating Non-Cellular Deck units shall be fastened at sidelaps and perimeter edges (sides located at perimeter supporting members) as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

E. Column closures, end closures, side closures and furnished slab edge forms shall be fastened as indicated on the manufacturer's erection drawings and as required by applicable SDI requirements for floor deck installation.

3.3 After Installation

A. Procedures for cutting, reinforcement, protection, repair, top surface cleaning, temporary shoring and concrete placement shall comply with applicable SDI requirements for floor deck installation.

B. Cellular and alternating Non-Cellular Deck units shall be examined by the electrical contractor and accepted for installation of compatible electrical components. The electrical contractor shall furnish and install tape for butt joints of Cellular Deck units and install Cellular Deck units that are supported by underlying concrete slabs.

C. Concrete shall be hand finished along both sides of trench header ducts. No traffic shall be permitted on trench header ducts until after adjacent concrete has adequately cured and installation of cover plate supports is complete.

SDI Short Form Specifications

FOR STEEL ROOF DECK

PART 1—GENERAL

1.1 Related Documents

A. General provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to work of this section.

1.2 Summary

A. This section shall include all materials, equipment and labor necessary for the installation of steel roof deck in accordance with this specification and design drawings.

B. Related work specified elsewhere.

1. Requirements for structural deck supports, field painting, fireproofing, roof sumps, flashings, drains, collars, gutters, downspouts, insulation and other miscellaneous items are specified elsewhere.

1.3. Submittals

A. **General:** Submit each item in this section according to the conditions of the contract and Division 1 Specification Section.

B. **Product Data:** Submit manufacturers' specifications/installation instructions for each steel roof deck type and specified accessories.

C. **Shop Drawings:** Submit roof deck placement drawings showing layout for each type of deck, anchorage details, sump pans, cut openings and accessories.

D. Welder certification signed by contractor certifying that welders comply with requirements specified under "Quality Assurance", or if mechanical fasteners are used, certification from the manufacturer evidencing compliance of mechanical fasteners with design requirements based upon comprehensive testing.

1.4 Quality Assurance

A. Codes and Standards—Comply with provisions of the following unless otherwise indicated.

1. American Iron and Steel Institute (AISI) Specification for Design of Cold Formed Steel Structural Members, latest edition.
2. American Welding Society (AWS) D1.3 Structural Welding Code/Sheet Metal.
3. Steel Deck Institute (SDI) Design Manual, latest edition.

B. Certify that each welder has satisfactorily passed AWS qualification test for the welding process involved, and, if applicable, has undergone recertification.

1.5 Delivery, Storage and Handling

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage and handling.

B. If ground storage is needed, the deck bundles must be stored off the ground, with one end elevated to provide drainage. Bundles must be protected against condensation with a ventilated waterproof covering. Bundles must be stacked so there is no danger of tipping, sliding, rolling, shifting or material damage. Bundles must be periodically checked for tightness and retightened as necessary (so wind cannot loosen sheets) to prevent damage caused by the wind.

C. Deck bundles placed on the building frame must always be placed near a main supporting beam at a column or wall. In no case are the bundles to be placed on unbolted frames or on unattached and unbridged joists. The structural frame must be properly braced to receive the bundles.

FOR STEEL ROOF DECK
Continued

PART 2—PRODUCTS

2.1 A manufacturer offering steel roof deck products to be incorporated into the work must be a member of the Steel Deck Institute.

2.2 Materials

A. Steel roof deck shall be (narrow rib) (intermediate rib) (wide rib) (deep rib) (long span) configuration _____ in depth with a design thickness of _____, and shall be designed in accordance with and comply with the standard load tables of the Roof Deck Specifications of the SDI.

B. Sheet steel for galvanized roof deck and accessories shall conform to ASTM A653-94 Structural Quality grade 33 (230 MPa) or higher.

1. Galvanizing shall conform to ASTM A924-94 with a minimum coating class of G60 (Z180) as defined in A653-94.

C. Sheet steel for primer painted roof deck and/or accessories shall conform to ASTM A611 with a minimum yield strength of 33 ksi (230 MPa).

1. Steel deck shall have a coat of manufacturers standard shop primer paint.

2.3 Accessories

A. The deck manufacturer shall furnish ridge and valley plates, flat plates at change of deck direction

D. and sump pans, as shown on plans to provide a finished surface for the application of roof insulation and roof covering.

PART 3—EXECUTION

3.1 Examine support framing and field conditions for compliance with requirements and installation tolerances and other conditions affecting performance of work of this section. All O.S.H.A., State and Local rules for erection must be followed.

3.2 Preparation

A. Place deck in accordance with approved placement plans.

B. Locate deck bundles to prevent overloading of support members.

3.3 Installation—General

A. Install deck panels and accessories according to SDI Specifications, SDI Manual of Construction with Steel Deck, and in accordance with the placement plans, and requirements of this section.

B. Place deck panels on structural supports and adjust to final position with ends lapped or butted over structural supports with a minimum end bearing of 1.5 inches (40 mm). Attach the deck panels firmly to the supports immediately after placement in order to form a safe working platform.

C. Cut and neatly fit deck and accessories at skew conditions, around openings and other work projecting through or adjacent to the decking.

Trades that subsequently cut unscheduled openings through the roof deck are responsible for reinforcing those openings in accordance with the requirements of the Engineer of Record.

3.4 Attachment

A. Anchor deck units to steel supporting members by arc spot puddle welds or approved mechanical fasteners.

1. Arc spot puddle welds shall be $\frac{5}{8}$ inch (15 mm) minimum visible diameter with the attachment pattern shown on placement drawings.
2. Mechanical fasteners, either powder actuated, pneumatically driven, or self drilling screws may be used in lieu of welding, provided product data has been submitted and approved.

Continued on next page

FOR STEEL ROOF DECK
Continued

B. Side lap attachment: Fasten side laps of deck units with spans greater than 5 feet (1.5 m) at mid span or 36″ (1 m) intervals, whichever distance is smaller, or as shown on design drawings using one of the following methods:

1. #10 self drilling screws.
2. Crimp or button punching.
3. Arc spot puddle welds 5/8 inch (15 mm) minimum visible diameter or 1 inch (25 mm) long arc seam or fillet weld.

C. Perimeter Edge Attachment: Fasten perimeter edges of deck units at minimum 36 inches (1 m) intervals or as shown on design drawings using one of the following methods:

1. Arc spot puddle welds 5/8 inch (15 mm) minimum visible diameter or 1 inch (25 mm) long arc seam or fillet weld.
2. Mechanical fasteners, either powder actuated, pneumatically driven or self drilling screws may be used in lieu of welding, provided product data has been submitted and approved.

D. Anchor accessories to supporting members by arc spot welds or self drilling screws at 12 inches (13 mm) maximum intervals or as shown on design drawings.

3.5 Repairs

A. Before placement of roof insulation and roof covering, the deck shall be inspected for tears, dents or other damage that may prevent the deck from acting as a structural roof base. The need for repair of the damaged deck shall be determined by the Architect or Engineer of Record.

3.6 Construction Guidelines

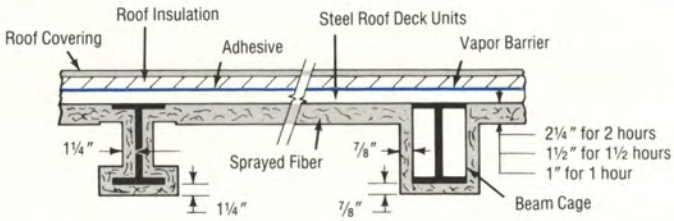
A. Do not use deck units as a working platform or storage area until units are permanently attached in position.

B. Construction loads must not exceed load carrying capacity of deck.

FIRE RESISTANCE RATINGS

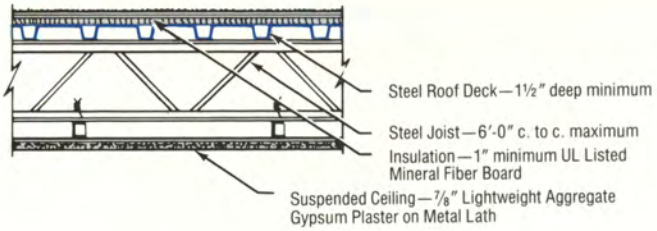
2-Hour Rating with Directly-Applied Protection

Illustration refers to UL Design P801 using a sprayed mineral fiber insulation. See also UL Designs P701, 711, and P805



2-Hour Rating with Metal Lath and Plaster Ceiling

Illustration refers to UL Design P404. See also UL Design P409.



Other 2-Hour Ratings

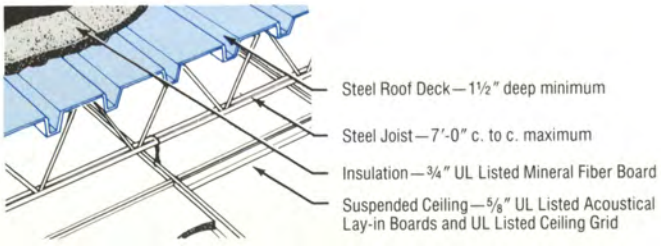
Although standard roof deck sections were not used for the following tests, it is the opinion of persons knowledgeable in fire test procedures that galvanized steel roof deck with a minimum depth of 1½ inches and a 0.0295-inch design thickness can be used without decreasing the fire resistance of the assembly. In each case, the assembly was tested using either a steel form unit with a minimum depth of $^{9}/_{16}$ inch or a steel floor deck essentially identical to products marketed as roof deck. The authorities having jurisdiction should be consulted before substituting steel roof deck in the following assemblies:

UL Designs P215 and P219: accoustical ceiling systems. 2 inches vermiculite concrete on special roof topping mixture on steel deck.

UL Design P902: no ceiling required. 2¾ inches cellular concrete on steel deck.

1-Hour Ratings with Suspended Acoustical Ceiling

Illustration refers to UL Design P201. See also UL Designs P204, P210, P211, P224, P232, P235, P238, and P243, and Factory Mutual Roof-Ceiling Construction 3-1 hour.



SPECIAL NOTICE

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Since hazards may be associated with the handling, installation, or use of steel and its accessories, prudent construction practices should always be followed. We recommend that parties involved in such handling, installation or use review all applicable manufacturers' material safety data sheets, applicable rules and regulations of the Occupational Safety and Health Administration and other government agencies having jurisdiction over such handling, installation or use, and other relevant construction practice publications.

The information presented in this manual has been prepared in accordance with generally recognized engineering principles. We recommend that this information not be used or relied upon for any application without a thorough review by a licensed professional engineer, designer or architect of the proposed application.

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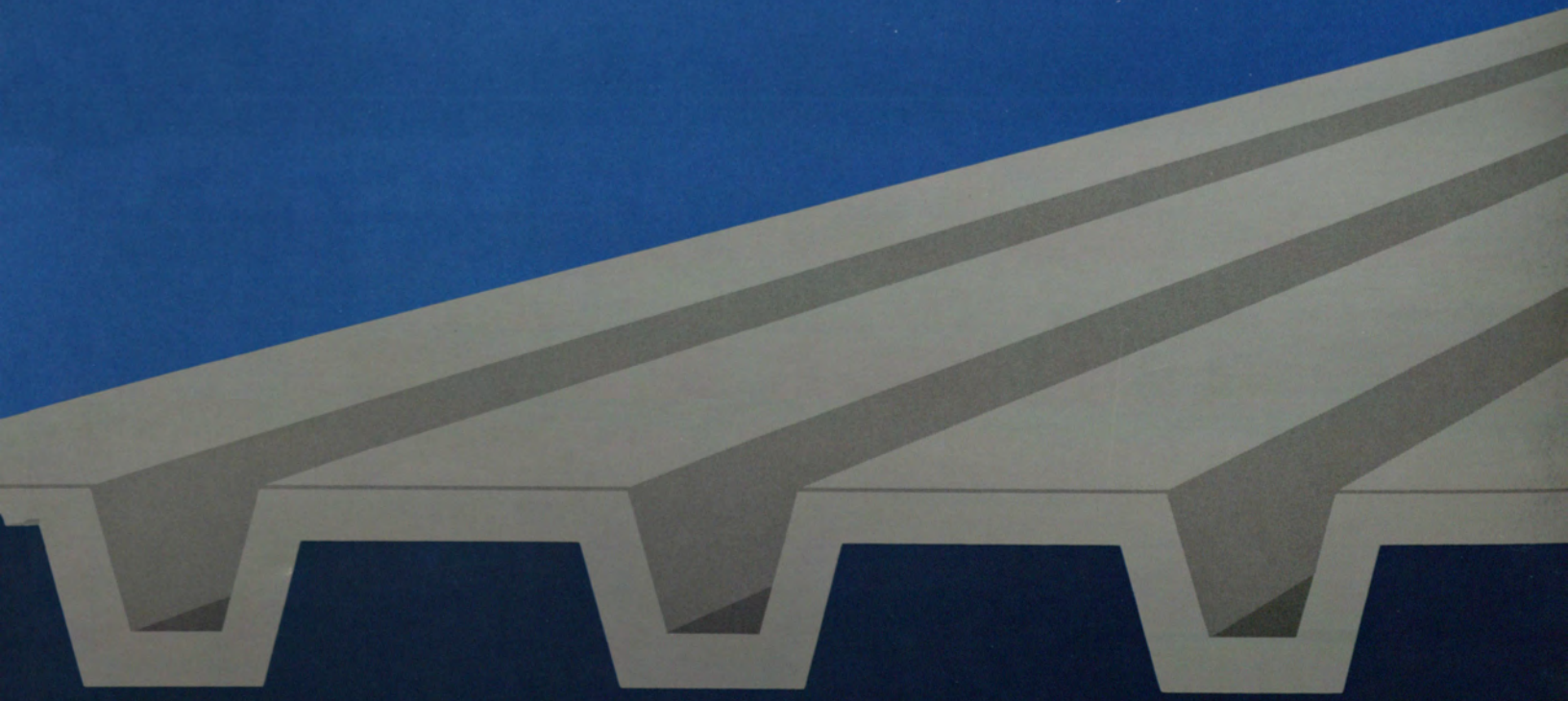

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